LS RESEARCH LLC
Wireless Product Development

ACCREDITED
TESTING CERT #1255.01

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TEST REPORT # 312067
LSR Job #: C-1568

Compliance Testing of:
ION10/ION12 Containing
2.4GHz WLAN Module with +11 dBi Antenna

Test Date(s):
October 11, 12, 17, 18, 24, 25, 29, November 2, 7, 8, 29, 30, 2012
May 1-7, 2014

Prepared For:
Attn: Greg Massey
Johnson Outdoors Marine Electronics
1220 Old Alpharetta Rd
Suite 340
Alpharetta, GA 30005

In accordance with:
Federal Communications Commission (FCC) Part 15, Subpart C, Section 15.247
Industry Canada (IC) RSS 210 Annex 8
Digital Modulation Transmitters (DTS) Operating in the
Frequency Band 2400 MHz – 2483.5 MHz

This Test Report is issued under the Authority of:
Peter Feilen, EMC Engineer

Signature: Date: 5/20/14

Test Report Reviewed by:
Ryan M Urness, Quality & Operations Manager

Signature: Date: 9/23/13

Tested by:
Peter Feilen, EMC Engineer

Signature: Date: 9/10/13

Contents

EXHIBIT 1. INTRODUCTION

1.1 Scope

References:	FCC Part 15, Subpart C, Section 15.247 RSS GEN and RSS 210 Annex 8
Title:	FCC : Telecommunication – Code of Federal Regulations, CFR 47, Part 15. IC : Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
Purpose of Test:	To gain FCC and IC Certification Authorization for Low-Power License-Exempt Transmitters.
Test Procedures:	Both conducted and radiated emissions measurements were conducted in accordance with American National Standards Institute ANSI C63.4 – American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

1.2 Normative References

Publication	Title
47 CFR, Parts 0-15 (FCC)	Code of Federal Regulations - Telecommunications
RSS 210 Annex 8	Low-power License-exempt Radio-communication Devices (All Frequency Bands): Category I Equipment
ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI C63.10	Part 15 Unlicensed Modular Transmitter Approval

1.3 LS Research, LLC Test Facility

LS Research, LLC is accredited by the requirements of ISO/IEC 17025, 2005 “General Requirements for the Competence of Calibration and Testing Laboratories”.

LS Research, LLC’s scope of accreditation includes all test methods listed herein, unless otherwise noted. Accreditation status can be verified at A2LA’s web site: a2la.org.

1.4 Location of Testing

All testing was performed at LS Research, LLC, W66 N220 Commerce Court, Cedarburg, Wisconsin, 53012 USA, utilizing the facilities listed below, unless otherwise noted.

1.5 Test Equipment Utilized

A complete list of equipment utilized in testing is provided in Appendix A of this test report. Calibration dates are indicated in Appendix A. All test equipment is calibrated by accredited calibration laboratories and traceable to SI standards.

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1 Client Information

Manufacturer Name:	Johnson Outdoors Marine Electronics
Address:	1220 Old Alpharetta Rd Suite 340 Alpharetta, GA 30005
Contact Name:	Greg Massey

2.2 Equipment Under Test (EUT) Information

The following information has been supplied by the applicant.

Product Name:	2.4 GHz Radio
Model Number:	TIWI-BLE
Serial Number:	Engineering Sample

2.3 Associated Antenna Description

This module is certified in conjunction with the following external antenna and connectors: 1. WPANT30059-RAP3 2.5 GHz Wi-Fi Omni-directional Antenna 2. Johnson Outdoors 490425-1 LMR-400 Coaxial cable 3. 407616-1 u.fl to Female N-type cable. The WPANT30059-RAP3 2.5 GHz Wi-Fi Omni-directional Antenna is a pole-mounted antenna with a gain of +11 dBi antenna.

2.4 EUT'S Technical Specifications

Additional Information:

EUT Frequency Range (in MHz)	WLAN: 2412-2462 MHz
Minimum RF Power in Watts	11b: 0.0977 W 11g: 0.0525 W 11n: 0.0240 W
Maximum RF Power in Watts	11b: 0.1380 W 11g: 0.0589 W 11n: 0.0275 W
Minimum Conducted Output Power (in dBm)	11b: 19.9 dBm 11g: 17.2 dBm 11n: 13.8 dBm
Maximum Conducted Output Power (in dBm)	11b: 21.4 dBm 11g: 17.7 dBm 11n: 14.4 dBm
Occupied Bandwidth (99% BW)	11b: 13.83 MHz 11g: 16.44 MHz 11n: 17.67 MHz
Emission Designator	11b: 13M8D2W 11g: 16M4D2W 11n: 17M7D2W
Type of Modulation	11b: QPSK 11g: BPSK 11n: 64-QAM
Transmitter Spurious (worst case) at 3 meters	47.4 dBuV/m @ 3m
Receiver Spurious (worst case) at 3 meters	39.5 dBuV/m @ 3m
Receiver Sensitivity	-92 dBm
Frequency Tolerance %, Hz, ppm	Better than 100 ppm
Transceiver Model # (if applicable)	CC2564
Antenna Information	
Detachable/non-detachable	Detachable
Type	Dipole
Gain, maximum (in dBi) Note: Gain obtained from data sheet	+11 dBi
EUT will be operated under FCC Rule Part(s)	15.247
EUT will be operated under RSS Rule Part(s)	RSS 210
Modular Filing	☒ Yes ☐ No
Portable or Mobile?	Portable

2.5 Product Description

The TIWI-BLE module is a multi-standard module with support for WLAN (802.11 b/g/n), Bluetooth and Bluetooth BLE, FM broadcast receiver with omni-directional dipole antenna.

EXHIBIT 3. EUT OPERATING CONDITIONS & CONFIGURATIONS DURING TESTS

3.1 Climate Test Conditions

Temperature:	15-35 ºC
Humidity:	30-60%
Pressure:	645-795 mmHg

3.2 Applicability & Summary of EMC Emission Test Results

FCC and IC Paragraph	Test Requirements	Compliance (Yes/No)
FCC : 15.247(b) & 1.1310 IC : RSS 210 A8.4	Maximum Output Power	Yes
FCC : 15.247(i), 1.1307, 1.1310, 2.1091 & 2.1093 IC : RSS 102	RF Exposure Limit	Yes
FCC :15.247(d) IC : RSS 210 A8.5	RF Conducted Spurious Emissions at the Transmitter Antenna Terminal	Yes
FCC:15.247 (a)(2) IC: RSS 210 A8.2 (a)	6 dB Bandwidth of a Digital Modulation System	Yes
FCC:15.247 (e) IC: RSS 210 A8.2 (b)	Power Spectral Density of a Digital Modulation System	Yes
IC : RSS GEN 4.6.1	99% Bandwidth	Yes
FCC : 15.247(d), 15.209 & 15.205 IC : RSS 210 A8.5, section 2.2 and 2.5	Transmitter Radiated Emissions	Yes
The digital circuit portion of the EUT has been tested and verified to comply with FCC Part 15, Subpart B, Class B Digital Devices (RSS GEN and RSS 210 of IC) and the associated Radio Receiver has also been tested and found to comply with Part 15, Subpart B.		

3.3 - Modifications Incorporated In The EUT For Compliance Purposes

☒ None ☐ Yes (explain below)

3.4 - Deviations & Exclusions From Test Specifications

☐ None ☒ Yes (explain below)

It is acknowledged that some of the data being used in the test report to show compliance is greater than 1 year in age. LS Research is requesting the use of this data on the basis that LS Research has measured and verified that the current samples of the product still correlate with previously measured data.

EXHIBIT 4. DECLARATION OF CONFORMITY

The EUT was found to MEET the requirements as described within the specification of FCC Title 47, CFR Part 15.247, and Industry Canada RSS-210, Issue 8, for a Digital Transmission System (DTS) transmitter.

Note: If some emissions are seen to be within 3 dB of their respective limits; as these levels are within the tolerances of the test equipment and site employed, there is a possibility that this unit, or a similar unit selected out of production may not meet the required limit specification if tested by another agency.

LS Research, LLC certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specifications. The results in this Test Report apply only to the item(s) tested on the above-specified dates. Any modifications made to the EUT subsequent to the indicated test date(s) will invalidate the data herein, and void this certification.

EXHIBIT 5. RADIATED EMISSIONS TEST

5.1 - Test Setup

The test setup was assembled in accordance with Title 47, CFR FCC Part 15, RSS 210, RSS GEN and ANSI C63.4-2003. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3 meter Semi-Anechoic, FCC listed Chamber. The EUT was operated in continuous modulated transmit mode for final testing using power as provided by a bench DC supply. 3 separate units were provided for testing on 3 different channels.

The applicable limits apply at a 3 meter distance. Measurements above 4 GHz were performed at a 1.0 meter separation distance. The calculations to determine these limits are detailed in the following pages. Please refer to Appendix A for a complete list of test equipment. The test sample was operated on one of three (3) standard channels: low (2402 MHz), middle (2440 MHz) and high (2480 MHz) to comply with FCC Part 15.31(m). The channels and operating modes were set via laptop computer and proprietary test software.

5.2 - Test Procedure

Radiated RF measurements were performed on the EUT in a 3 meter Semi-Anechoic, FCC listed Chamber. The frequency range from 30 MHz to 25000 MHz was scanned and investigated. The radiated RF emission levels were manually noted at the various fixed degree settings of azimuth on the turntable and antenna height. The EUT was placed on a non-conductive pedestal in the 3 meter Semi-Anechoic Chamber, with the antenna mast placed such that the antenna was 3 meters from the EUT. A Bi-conical Antenna was used to measure emissions from 30 MHz to 300 MHz, and a Log Periodic Antenna was used to measure emissions from 300 MHz to 1000 MHz A Double-Ridged Waveguide Horn Antenna was used from 1 GHz to 18 GHz. A standard gain horn antenna and pre-amp were used to measure from 18-25 GHz. The maximum radiated RF emissions were found by raising and lowering the antenna between 1 and 4 meters in height, using both horizontal and vertical antenna polarities.

The EUT was rotated along three orthogonal axes during the investigations to find the highest emission levels.

5.3 - Test Equipment Utilized

A list of the test equipment and antennas utilized for the Radiated Emissions test can be found in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated and used according to the operation manuals supplied by the manufacturers. All calibrations of the antennas used were performed at an IEC/ISO 17025 accredited calibration laboratory, traceable to SI standards. In addition, the Connecting Cables were measured for losses using a calibrated Signal Generator and an EMI Receiver. The resulting correction factors and the cable loss factors from these calibrations were entered into the EMI Receiver database. As a result, the data taken from the EMI Receiver accounts for the antenna correction factor as well as cable loss or other corrections, and can therefore be entered into the database as a corrected meter reading. The EMI Receiver was operated with resolution bandwidths as prescribed in ANSI C63.4.

5.4 - Test Results

The EUT was found to **MEET** the Radiated Emissions requirements of Title 47 CFR, FCC Part 15.247 and Canada RSS-210, Issue 8, for a DTS transmitter. The frequencies with significant RF signal strength were recorded and plotted as shown in the Data Charts and Graphs.

5.5 - Calculation of Radiated Emissions Limits

The maximum peak output power of an intentional radiator in the 2400 to 2483.5 MHz band, as specified in Title 47 CFR 15.247 and RSS 210 is 1 Watt. The harmonic and spurious RF emissions, as measured in any 100 kHz bandwidth, as specified in 15.247(d) and RSS 210 A8.5, shall be at least 20 dB below the measured power of the desired signal, and must also meet the requirements described in 15.205(c) for FCC and section 2.2, 2.6 and 2.7 of RSS 210 for IC.

The following table depicts the general radiated emission limits above 30 MHz. These limits are obtained from Title 47 CFR, Part 15.209, for radiated emissions measurements. These limits were applied to any signals found in the 15.205 restricted bands. The mentioned limits correspond to those limits listed in RSS 210 section 2.7.

Frequency (MHz)	3 m Limit μV/m	3 m Limit (dBμV/m)	1 m Limit (dBμV/m)
30-88	100	40.0	-
88-216	150	43.5	-
216-960	200	46.0	-
960-24,000	500	54.0	63.5

Sample conversion of field strength (μV/m to dBμV/m):
$dB\mu V/m = 20 \log_{10} (100) = 40$ dBμV/m (from 30-88 MHz)

For measurements made at 1.0 meter, a 9.5 dB correction has been invoked.

960 MHz to 10,000 MHz
500μV/m or 54.0 dB/μV/m at 3 meters
54.0 + 9.5 = 63.5 dB/μV/m at 1 meter

Sample Calculation using correction factors from the device

Raw Receiver Data + Antenna Factor + Cable Factor + = Reported Value

Generic example of reported data at 200 MHz:

Reported Measurement data = 18.2 (raw receiver measurement) + 15.8 (antenna factor) + 1.45 (cable factor) =
= 35.45 dBuV/m

5.6 - Radiated Emissions Test Data Chart

Manufacturer:	Johnson Outdoors Marine Electronics					
Date(s) of Test:	October 11, 12, 17, 18, November 2, 29, 30, 2012					
Project Engineer:	Peter Feilen					
Voltage:	3.6 VDC					
Operation Mode:	Continuous modulated transmit mode					
Environmental Conditions in the Lab:	Temperature: 71˚F Relative Humidity: 32 %					
EUT Power:		Single Phase ___VAC		3 Phase ___VAC		
		Battery	X	Other: Bench DC Supply		
EUT Placement:	X	80cm non-conductive table		10cm Spacers		
EUT Test Location:	X	3 Meter Semi-Anechoic FCC Listed Chamber		3/10m OATS		
Measurements:		Pre-Compliance		Preliminary	X	Final
Detectors Used:	X	Peak	X	Quasi-Peak	X	Average

Significant Spurious Emissions Other Than Harmonics of the Fundamental

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Average Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
127.4	3.13	192	43.6	40.2	32.3	43.5	3.4	H	V
116.0	3.18	230	38.9	35.0	22.0	43.5	8.5	H	V
122.0	2.62	35	37.9	34.6	26.6	43.5	8.9	H	V
126.7	1.05	311	41.42	37.9	30.0	43.5	5.6	V	V
115.9	1.00	328	38.79	35.5	27.8	43.5	8.1	V	V
98.5	1.00	327	38.9	35.9	28.0	43.5	7.6	V	V
75.1	1.00	43	35.7	33.5	26.2	40.0	6.5	V	V
86.9	2.01	65	35.4	32.9	25.6	40.0	7.1	V	V
127.3	1.00	329	42.0	38.1	30.5	43.5	5.4	V	S
115.9	1.00	0	38.7	35.5	27.8	43.5	8.0	V	S
98.2	1.09	0	39.3	36.5	28.9	43.5	7.1	V	S
75.3	1.05	68	35.4	33.2	26.2	40.0	6.8	V	S
127.4	2.99	0	43.6	40.3	32.6	43.5	3.3	H	S
121.7	2.97	27	39.6	34.9	27.2	43.5	8.6	H	S
116.7	2.94	38	41.1	35.7	23.1	43.5	7.8	H	S
128.0	2.97	197	43.7	40.0	31.4	43.5	3.5	H	F
122.3	2.85	11	38.5	34.6	26.4	43.5	8.9	H	F
116.3	2.94	37	41.8	38.5	30.6	43.5	5.0	H	F
128.0	1.03	321	41.6	37.8	29.6	43.5	5.7	V	F
116.5	1.02	0	39.7	35.5	26.8	43.5	8.0	V	F
99.0	1.08	0	39.0	35.6	27.2	43.5	7.9	V	F

Wi-Fi: Stand Alone Module

The following table depicts the level of significant radiated harmonic emissions seen on Channel Low:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4824	1.24	194	48.1	44.2	54.0	9.8	Horizontal	Vertical

The following table depicts the level of significant radiated harmonic emissions seen on Channel Middle:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4874	1.40	76	50.6	47.4	54.0	6.6	Horizontal	Side

The following table depicts the level of significant radiated harmonic emissions seen on Channel High:

Frequency (MHz)	**Height (m)**	**Azimuth (degree)**	**Peak Reading (dBµV/m)**	**Avg Reading (dBµV/m)**	**Avg Limit (dBµV/m)**	**Margin (dB)**	**Antenna Polarity**	**EUT orientation**
4924	1.10	125	42.2	35.3	54.0	18.7	Horizontal	Vertical
7386	1.08	82	44.4	35.8	54.0	18.2	Vertical	Flat

Wi-Fi: With Enclosure:

The following table depicts the level of significant radiated harmonic emissions seen on Channel Low:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4824	1.00	214	47.5	39.2	54.0	14.8	Vertical	Side

The following table depicts the level of significant radiated harmonic emissions seen on Channel Middle:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4874	1.46	212	46.6	38.8	54.0	15.2	Vertical	Side

The following table depicts the level of significant radiated harmonic emissions seen on Channel High:

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Avg Reading (dBµV/m)	Avg Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
4924	1.23	215	44.8	36.8	54.0	17.2	Vertical	Side

Notes:

1. A Quasi-Peak Detector was used in measurements below 1 GHz. To ensure the peak emissions did not exceed 20 dB above the limits a peak detector was used. A peak detector with video averaging was used for measurements above 1 GHz.
2. Measurements above 18 GHz were made at 1 meters of separation from the EUT. Limits reflect the measurement distance.

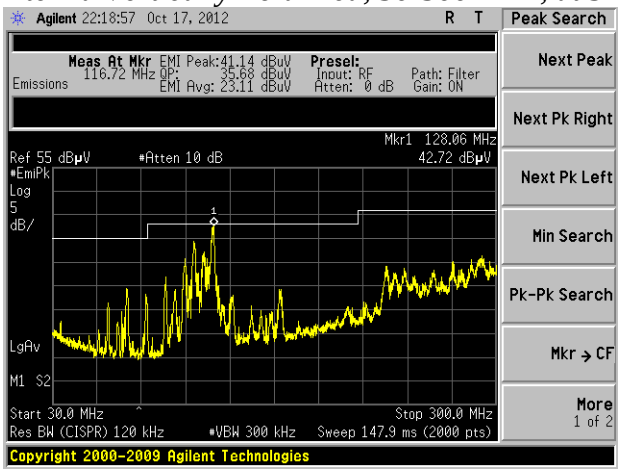
5.8 - Screen Captures - Radiated Emissions Test Transmit Mode

These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and a video averaged Peak detector function is utilized when measuring frequencies above 1 GHz.

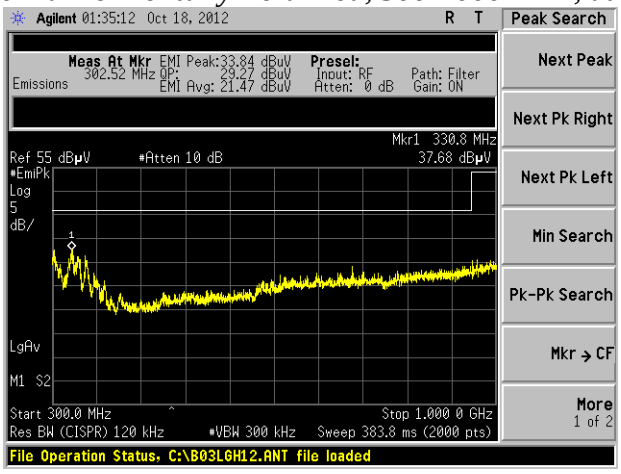
The signature scans shown here are from worst-case emissions, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

WLAN Radiated Emissions: Stand Alone Module

Antenna Vertically Polarized, 30-300 MHz, at 3m

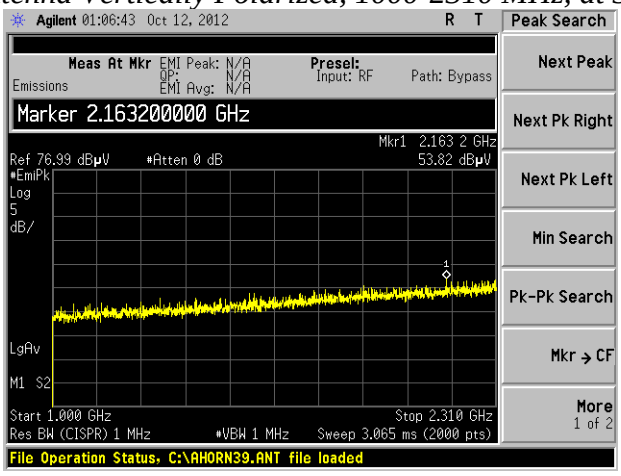


Antenna Horizontally Polarized, 300-1000 MHz, at 3m



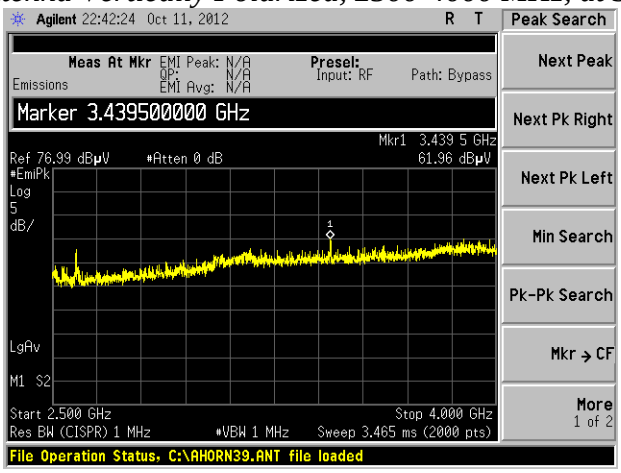
Radiated Emissions Screen Captures (cont.)

Antenna Vertically Polarized, 1000-2310 MHz, at 3m



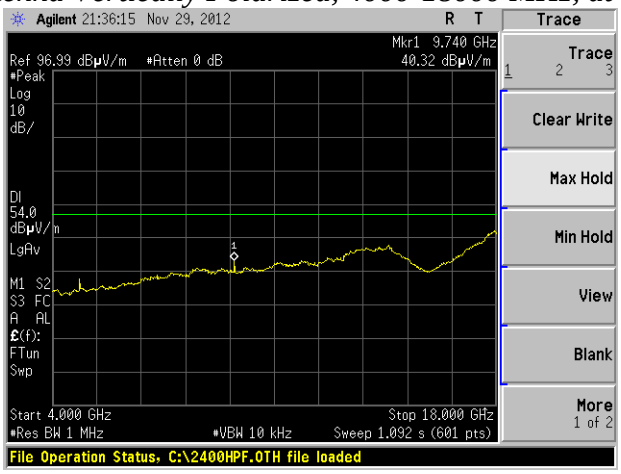
Note: The frequency range 2310-2390 MHz, 2390-2400 MHz, and 2483.5-2500 MHz is in the Band-edge section (Exhibit 7).

Antenna Vertically Polarized, 2500-4000 MHz, at 3m

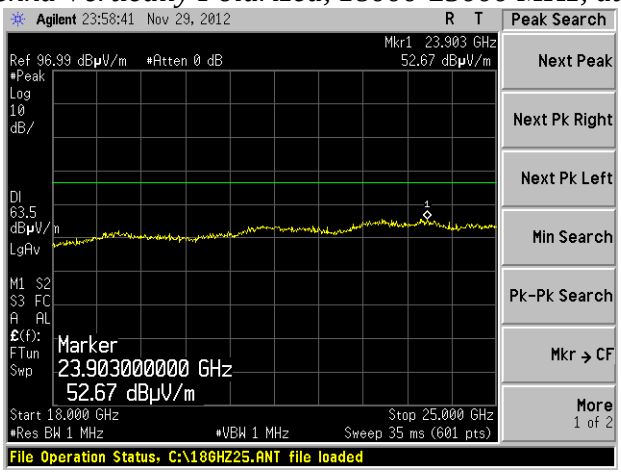


Radiated Emissions Screen Captures (cont.)

Antenna Vertically Polarized, 4000-18000 MHz, at 1m

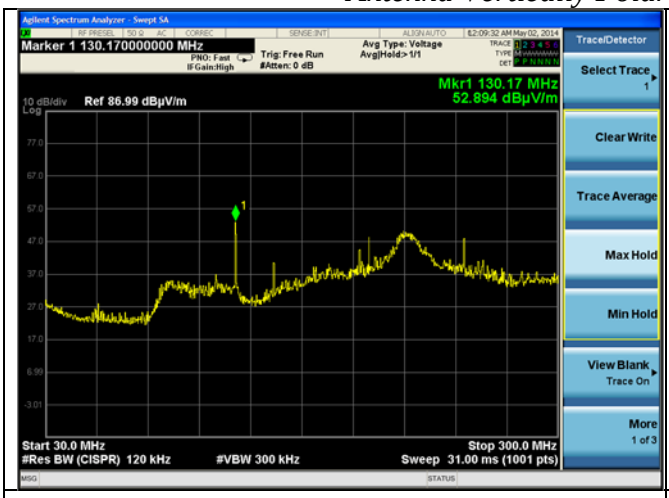


Antenna Vertically Polarized, 18000-25000 MHz, at 1m



WLAN Radiated Emissions in Enclosure

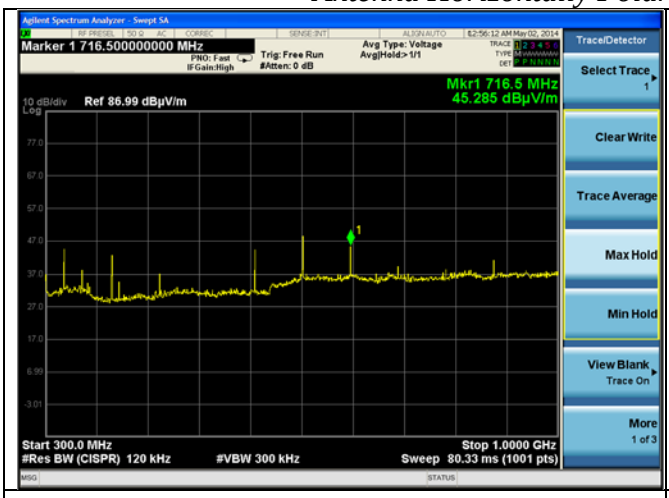
Antenna Vertically Polarized, 30-300 MHz, at 3m



Radio On

Radio Off

Antenna Horizontally Polarized, 300-1000 MHz, at 3m

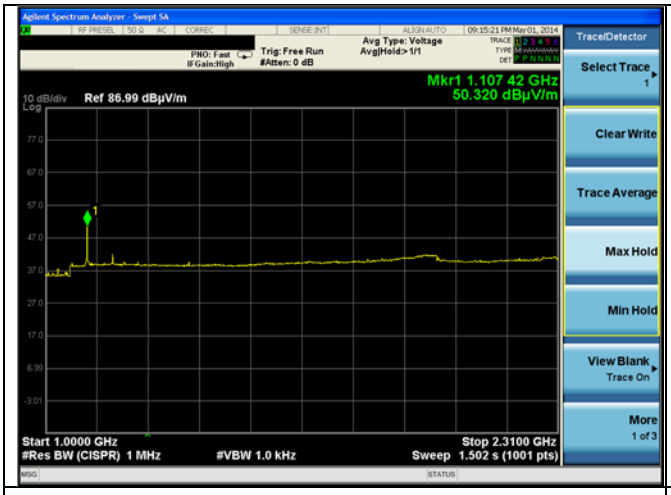


Radio On

Radio Off

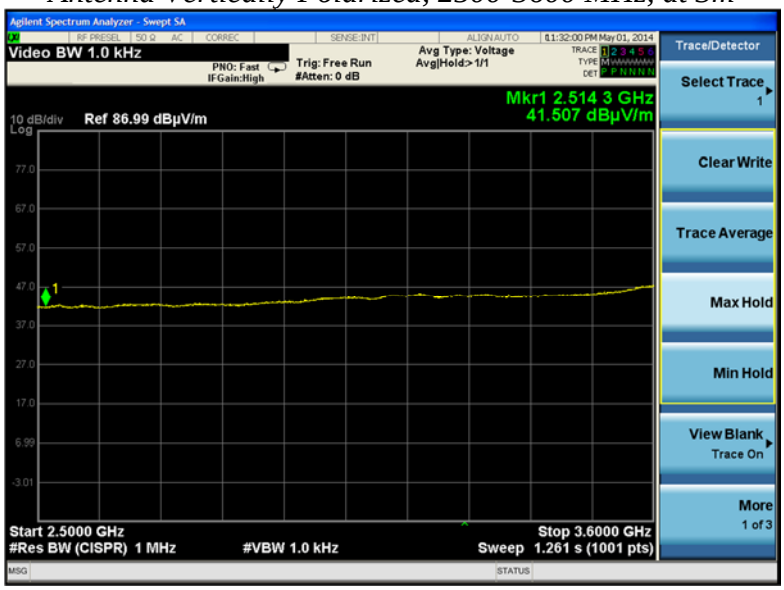
Radiated Emissions Screen Captures (cont.)

Antenna Vertically Polarized, 1000-2310 MHz, at 3m

	
Radio On	*Radio Off*

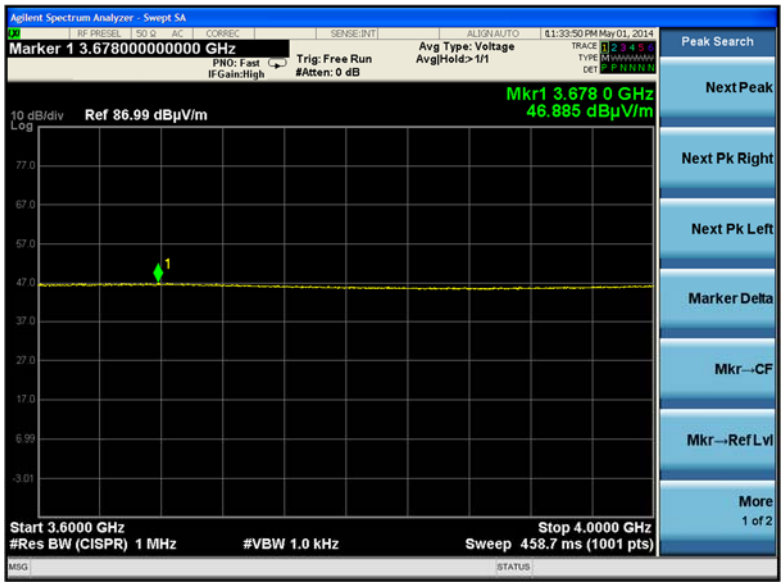
Note: The frequency range 2310-2390 MHz, 2390-2400 MHz, and 2483.5-2500 MHz is in the Band-edge section (Exhibit 7).

Antenna Vertically Polarized, 2500-3600 MHz, at 3m



Radiated Emissions Screen Captures (cont.)

Antenna Vertically Polarized, 3600-4000 MHz, at 3m



Radiated Emissions Screen Captures (cont.)

Antenna Vertically Polarized, 4000-18000 MHz, at 1m

Notes:

1. No significant emissions were noted

5.9 - Receive Mode Testing

Test Setup

Per the requirements of RSS-210 and CFR 47 part 15, the EUT was placed in continuous receive mode and the radiated spurious emissions were measured and compared to the limits stated in RSS-Gen Section 4.10 and CFR 47 15.109.

The test setup, procedure, and equipment utilized were identical to that described in sections 5.1, 5.2, and 5.3 of this document.

Test Data

Frequency (MHz)	Height (m)	Azimuth (degree)	Peak Reading (dBµV/m)	Quasi Peak Reading (dBµV/m)	Average Reading (dBµV/m)	Quasi Peak Limit (dBµV/m)	Margin (dB)	Antenna Polarity	EUT orientation
126.0	3.00	202	43.0	38.8	29.5	43.5	4.7	H	V
120.6	3.01	0	40.5	37.2	29.4	43.5	6.3	H	V
115.2	2.71	22	39.0	35.6	26.5	43.5	7.9	H	V
109.0	2.52	47	39.0	35.6	27.1	43.5	7.9	H	V
126.6	1.00	318	40.4	37.1	28.2	43.5	6.4	V	V
137.8	1.00	336	39.1	35.4	27.5	43.5	8.2	V	V
97.2	3.71	0	38.89	34.5	23.6	43.5	9.1	V	V
126.2	1.00	343	40.89	37.1	26.7	43.5	6.4	V	S
138.0	1.00	0	38.4	35.0	27.3	43.5	8.6	V	S
120.8	1.00	312	37.3	33.9	25.9	43.5	9.6	V	S
97.6	1.00	328	39.7	36.5	27.8	43.5	7.0	V	S
126.2	2.98	199	43.2	39.5	30.7	43.5	4.0	H	S
120.8	2.84	204	40.8	37.3	29.7	43.5	6.2	H	S
115.0	2.77	26	39.4	35.9	28.2	43.5	7.6	H	S
126.7	3.19	189	42.6	39.4	31.0	43.5	4.1	H	F
121.2	2.79	206	40.6	36.8	27.5	43.5	6.7	H	F
115.4	2.84	20	39.6	36.0	26.9	43.5	7.5	H	F
126.5	1.00	314	39.7	36.5	28.6	43.5	7.0	V	F
137.8	1.00	326	38.7	35.0	26.4	43.5	8.5	V	F
97.5	1.00	319	39.5	35.8	26.6	43.5	7.7	V	F
334.1	1.00	312	41.5	36.6	29.0	46.0	9.4	H	F
332.6	1.00	307	42.7	37.1	29.3	46.0	8.9	H	F
332.9	1.00	305	42.4	37.1	29.4	46.0	9.0	H	F

5.10 - Screen Captures - Radiated Emissions Testing – Receive Mode

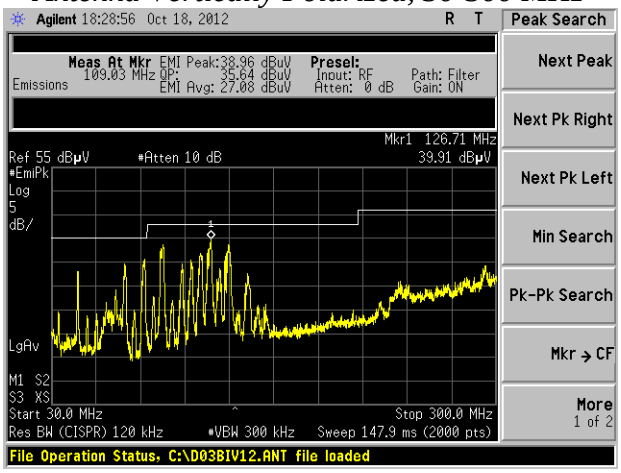
These screen captures represent Peak Emissions. For radiated emission measurements, a Quasi-Peak detector function is utilized when measuring frequencies below 1 GHz, and a video averaged Peak detector function is utilized when measuring frequencies above 1 GHz.

The signature scans shown here are from worst-case emissions, with the sense antenna both in vertical and horizontal polarity for worst case presentations.

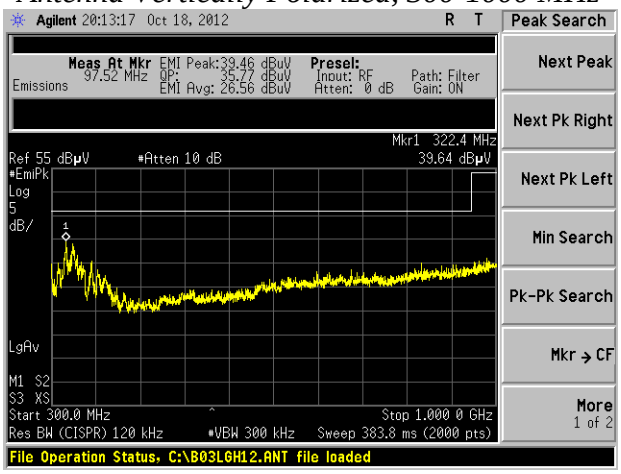
Screen captures from the receive tests are presented below:

Wi-Fi:

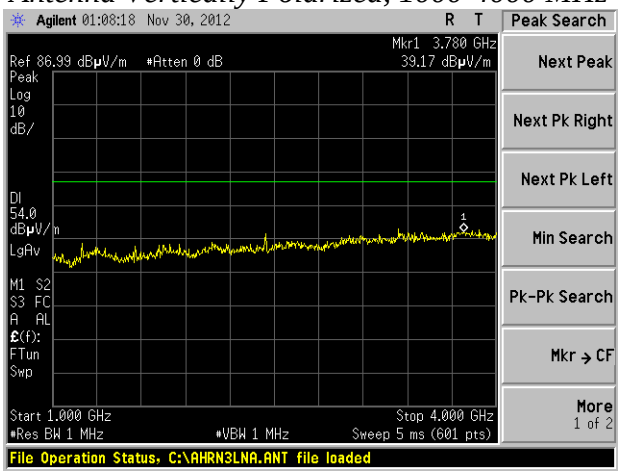
Antenna Vertically Polarized, 30-300 MHz



Antenna Vertically Polarized, 300-1000 MHz

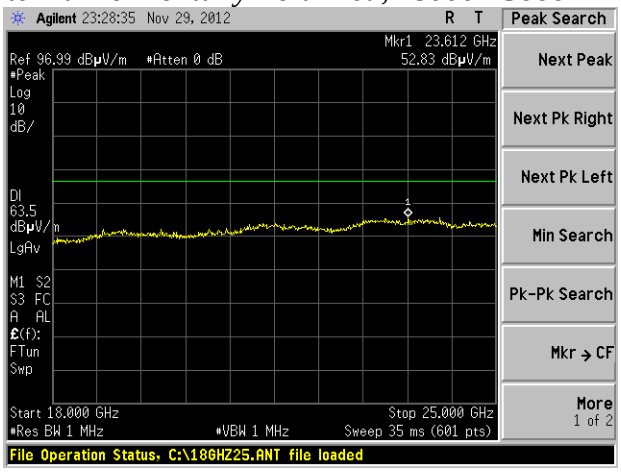


Antenna Vertically Polarized, 1000-4000 MHz



Antenna Horizontally Polarized, 4000-18000 MHz

Antenna Horizontally Polarized, 18000-25000 MHz



Notes:

1. No significant emissions were noted
2. Measurements above 4 GHz were made at 1 meters of separation from the EUT.

EXHIBIT 6. CONDUCTED EMISSIONS TEST, AC POWER LINE

6.1 - Test Setup

The test area and setup are in accordance with ANSI C63.4-2003 and with Title 47 CFR, FCC Part 15 and RSS GEN. The EUT was placed on a non-conductive wooden table, with a height of 80 cm above the reference ground plane. The EUT's power cable was plugged into a 50Ω (ohm), 50/250 μH Line Impedance Stabilization Network (LISN). The AC power supply of 120V was provided via an appropriate broadband EMI Filter, and then to the LISN line input. Final readings were then taken and recorded. After the EUT was setup and connected to the LISN, the RF Sampling Port of the LISN was connected to a 10 dB Attenuator-Limiter, and then to the EMI Receiver. The EMCO LISN used has the ability to terminate the unused port with a 50Ω (ohm) load when switched to either L1 (line) or L2 (neutral).

6.2 - Test Procedure

The EUT was investigated in continuous modulated transmit mode and continuous receive mode for this portion of the testing. The appropriate frequency range and bandwidths were selected on the EMI Receiver, and measurements were made. The bandwidth used for these measurements is 9 kHz, as specified in CISPR 16-1, Section 1, Table 1, for Quasi-Peak and Average detectors in the frequency range of 150 kHz to 30 MHz. Final readings were then taken and recorded.

An off-the-shelf DC power supply was used during the test to supply the EUT with the appropriate DC voltage.

6.3 - Test Equipment Utilized

A list of the test equipment and accessories utilized for the Conducted Emissions test is provided in Appendix A. This list includes calibration information and equipment descriptions. All equipment is calibrated by accredited calibration laboratories and used according to the operation manuals supplied by the manufacturers. Calibrations of the LISN and Limiter are traceable to SI standards. All cables are calibrated and checked periodically for conformance. The emissions are measured on the EMI Receiver, which has automatic correction for all factors stored in memory and allows direct readings to be taken.

6.4 - Test Results

The EUT was found to **MEET** the Conducted Emission requirements of FCC CFR 47 Part **15.207** and **15.107**, Conducted Emissions. See the Data Charts and Graphs for more details of the test results. By virtue of meeting the requirements of FCC, the EUT also meets the requirements of IC **RSS GEN**.

6.5 - FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	**Class B Limits (dBµV)**		**Measuring Bandwidth**
	Quasi-Peak	Average	
0.150 -0.50 *	66-56	56-46	RBW = 9 kHz VBW ≥ 9 kHz for QP VBW = 1 Hz for Average
0.5 – 5.0	56	46	
5.0 – 30	60	50	
* The limit decreases linearly with the logarithm of the frequency in this range.			

6.6 – Conducted Emissions Test Data Chart

Frequency Range inspected: 150 KHz to 30 MHz
Test Standard: FCC 15.207 Class B
IC RSS GEN 7.2.2

Manufacturer:	Johnson Outdoors Marine Electronics					
Date(s) of Test:	December 4, 2012					
Project Engineer:	Peter Feilen					
Test Engineer:	Mike Hintzke					
Voltage:	3.6 VDC					
Operation Mode:	Continuous transmit and continuous receive					
Environmental Conditions in the Lab:	Temperature: 20 – 25° C Relative Humidity: 30 – 60 %					
Test Location:						Chamber
EUT Placed On:	X	40cm from Vertical Ground Plane				10cm Spacers
	X	80cm above Ground Plane				Other:
Measurements:		Pre-Compliance		Preliminary	X	Final
Detector Used:	X	Peak	X	Quasi-Peak	X	Average

6.6.1 – Conducted Emissions Test Data

		Quasi-Peak			Average		
Frequency (MHz)	Line	Q-Peak Reading (dBµV)	Q-Peak Limit (dBµV)	Quasi-Peak Margin (dB)	Average Reading (dBµV)	Average Limit (dBµV)	Average Margin (dB)
0.302	L1	48.27	60.200	11.930	47.8	50.200	2.400
0.201	L1	47.6	63.570	15.970	45.36	53.570	8.210
21.090	L1	32.42	60.000	27.580	30.31	50.000	19.690
0.302	L2	48.18	60.189	12.009	47.64	50.189	2.549
0.402	L2	42.07	57.814	15.744	39.48	47.814	8.334
21.090	L2	36.82	60.000	23.180	32.34	50.000	17.660

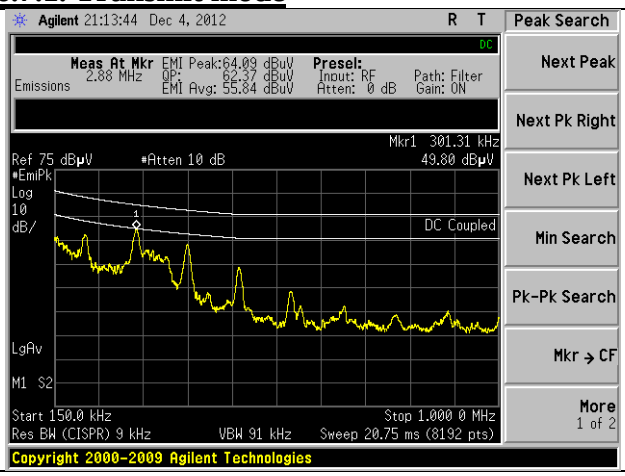
Notes:
1) The emissions listed are characteristic of the power supply used, and did not change by the EUT operating mode (WiFi or BLE).
2) All other emissions were better than 20 dB below the limits.
3) The EUT exhibited similar emissions across the Low and High channels tested, in transmit and receive mode
4) Measured levels and limits are in units of dBuV/m.

6.7 - Screen Captures – Conducted Emissions Test

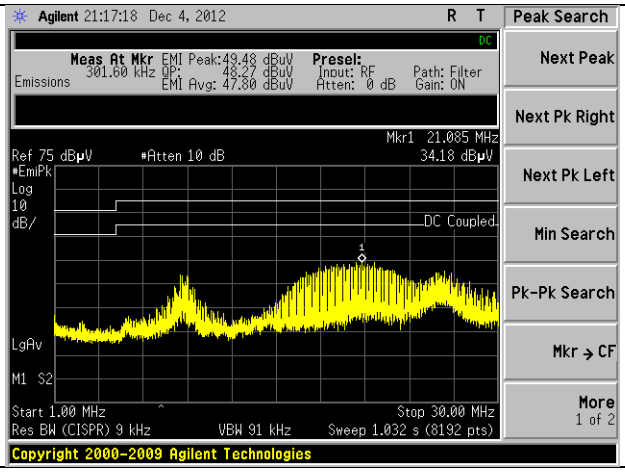
These screen captures represent Peak Emissions. For conducted emission measurements, both a Quasi-Peak detector function and an Average detector function are utilized. The emissions must meet both the Quasi-peak limit and the Average limit as described in 47 CFR 15.207, 47 CFR 15.107 and RSS GEN 7.2.2 (Table 2).

The signature scans shown here are from the middle channel chosen as being a good representative of channels.

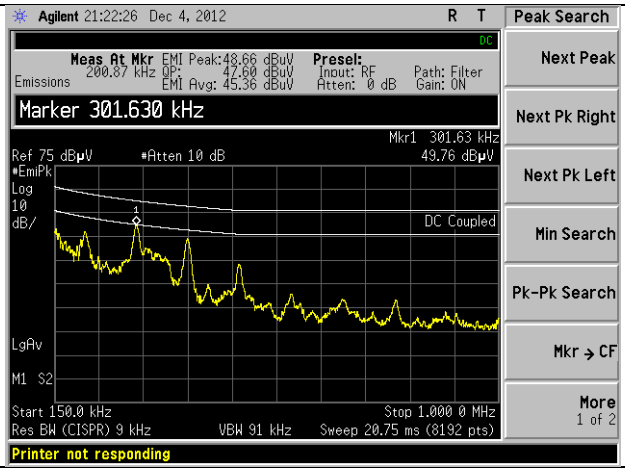
6.7.1. Transmit mode



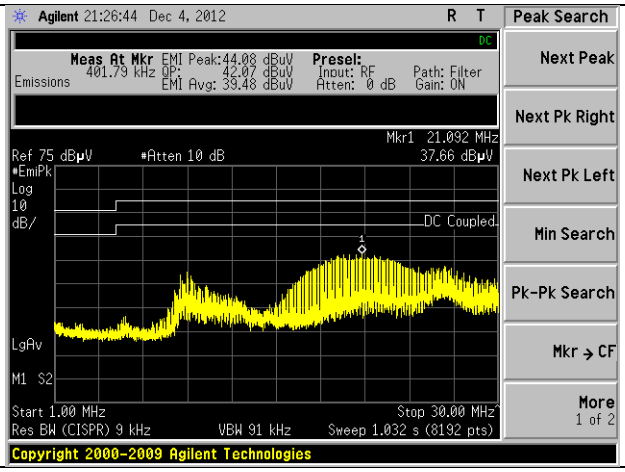
Line 1



Line 1

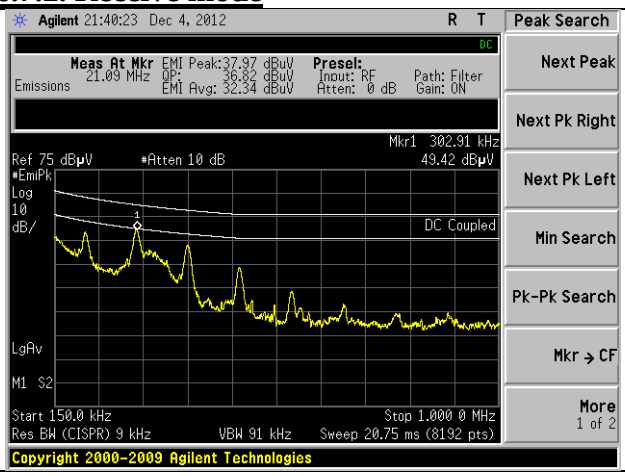


Line 2

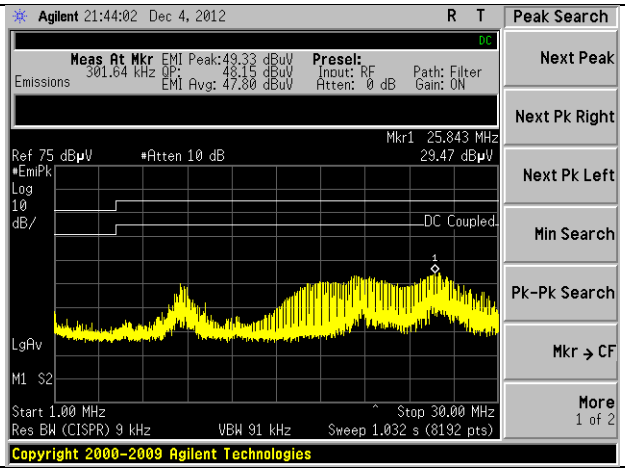


Line 2

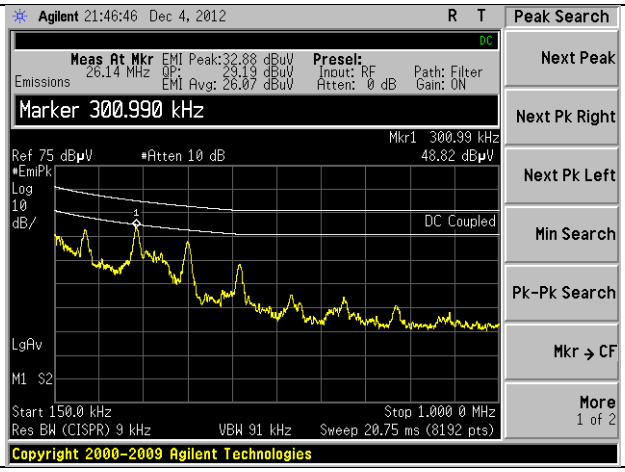
6.7.2. Receive mode



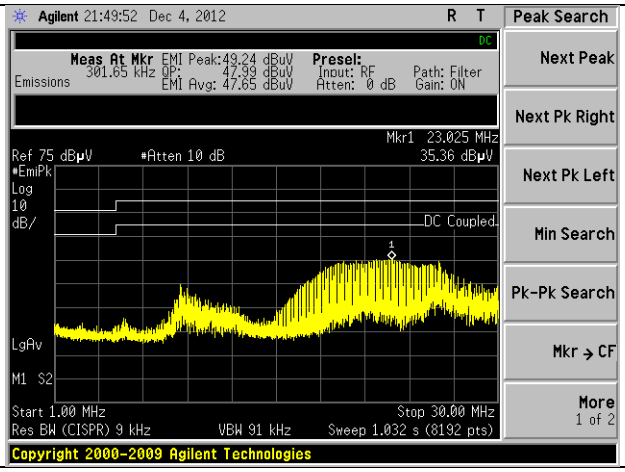
Line 1



Line 1



Line 2



Line 2

EXHIBIT 7. OCCUPIED BANDWIDTH:

7.1 Limits

For a DTS system operating in the 2400 to 2483.5 MHz band, the 6dB emission bandwidth minimum is 500 kHz.

7.2 Method of Measurements

Industry Canada (IC RSS GEN 4.6.1) also requires the measurement of the 99% bandwidth in addition to the 6 dB emission bandwidth. For this portion of the tests, a direct measurement of the transmitted signal was performed at the antenna port of the EUT, via a cable connection to a spectrum analyzer. An attenuator was placed in series with the cable to protect the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings there by allowing direct measurements, without the need for any further corrections. The EUT was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. A bandwidth measurement function that is built into the spectrum analyzer was used to measure the 99 % bandwidth while the.

7.3 Test Equipment List

Please see Appendix A

7.4 Test Results

From this data, the closest measurement (6 dB bandwidth) when compared to the specified limit, is 667 kHz, which is greater than the minimum of 500 kHz.

7.5 Test Data

Wi-Fi:

1 MBPS

Channel	Frequency (MHz)	-6 dBc BW (MHz)	99% BW (MHz)
1	2412	9.13	13.68
2	2417	9.13	13.80
3	2424	9.13	13.83
6	2437	9.13	13.69
11	2462	9.13	13.60

54 MBPS

Channel	Frequency (MHz)	-6 dBc BW (MHz)	99% BW (MHz)
1	2412	16.43	15.84
2	2417	16.43	16.44
3	2424	16.43	16.29
6	2437	16.43	16.39
11	2462	16.50	15.68

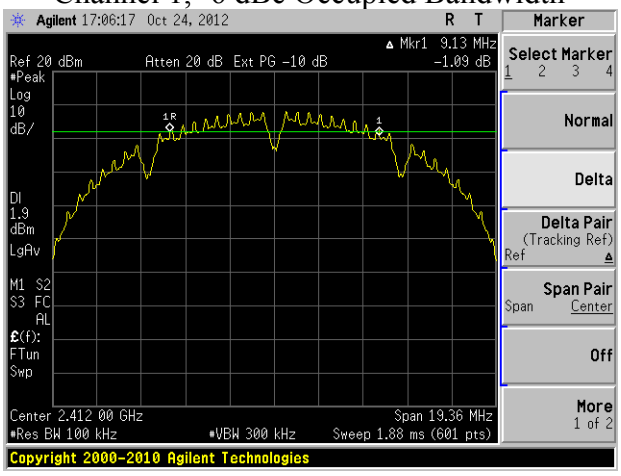
MCS7

Channel	Frequency (MHz)	-6 dBc BW (MHz)	99% BW (MHz)
1	2412	17.73	17.60
2	2417	17.59	17.67
3	2424	17.60	17.58
6	2437	17.57	17.49
11	2462	17.57	17.53

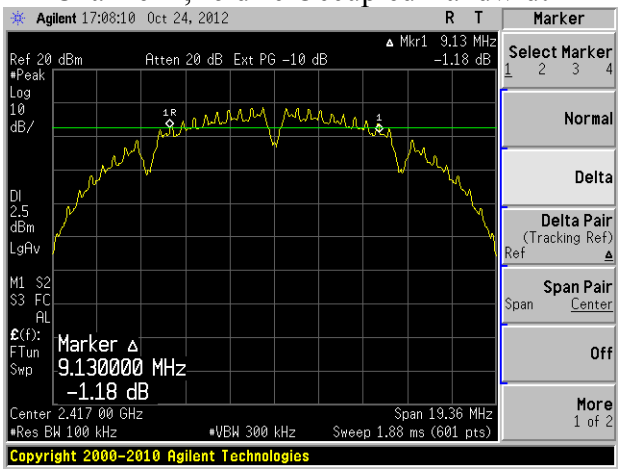
7.6 Screen Captures – Occupied Bandwidth

1 MBPS

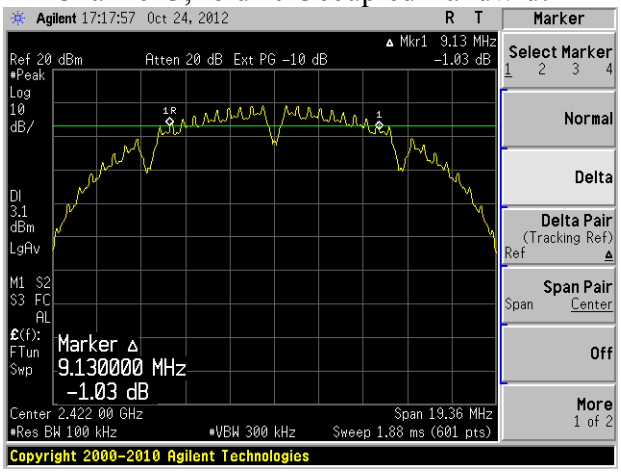
Channel 1, -6 dBc Occupied Bandwidth



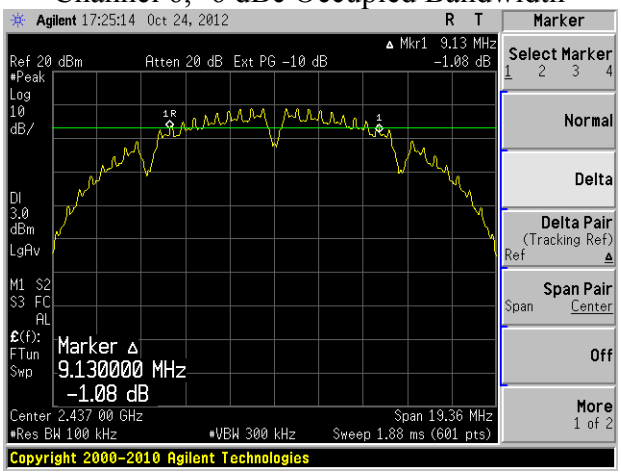
Channel 2, -6 dBc Occupied Bandwidth



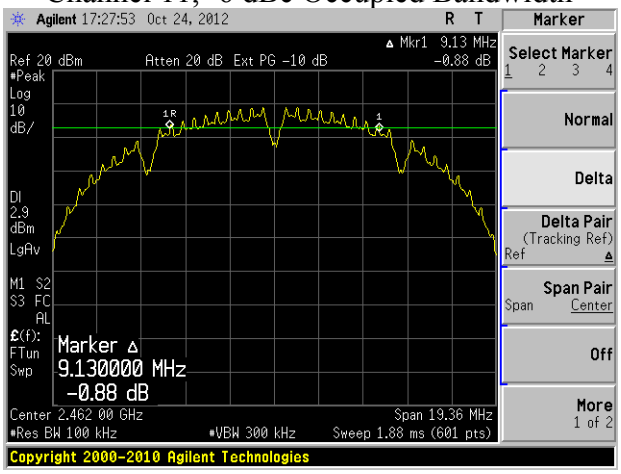
Channel 3, -6 dBc Occupied Bandwidth



Channel 6, -6 dBc Occupied Bandwidth

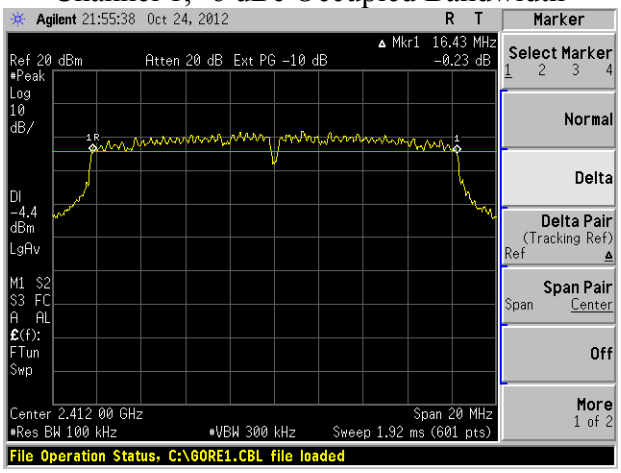


Channel 11, -6 dBc Occupied Bandwidth

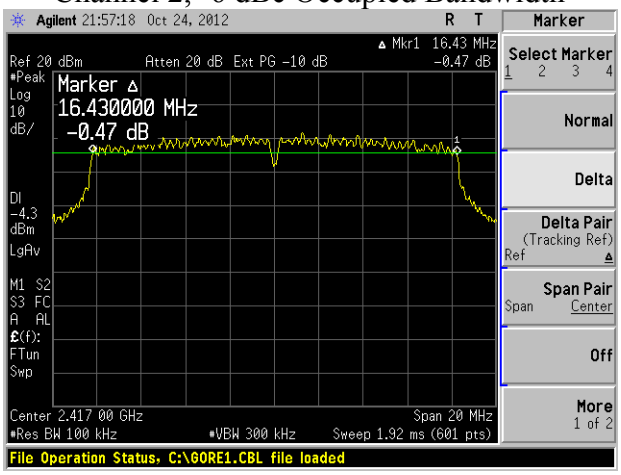


54 MBPS

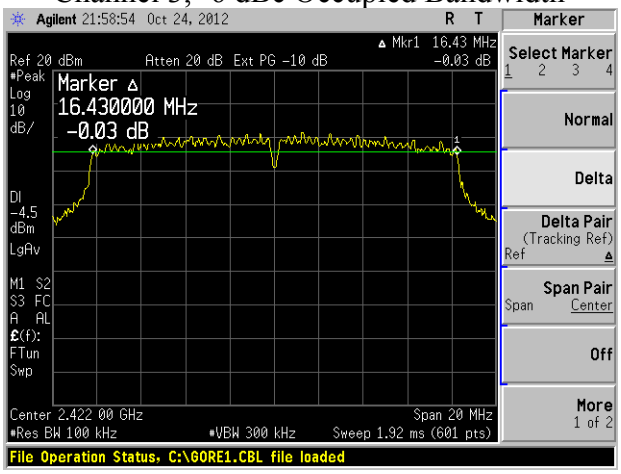
Channel 1, -6 dBc Occupied Bandwidth



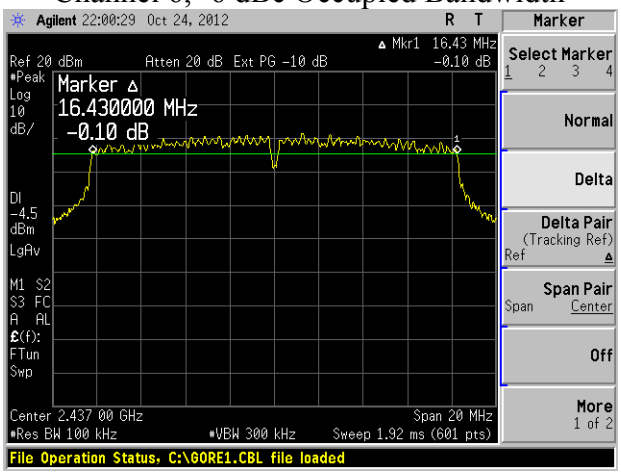
Channel 2, -6 dBc Occupied Bandwidth



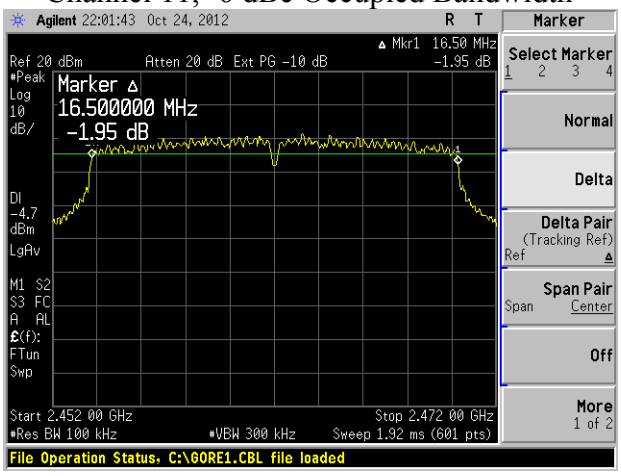
Channel 3, -6 dBc Occupied Bandwidth



Channel 6, -6 dBc Occupied Bandwidth

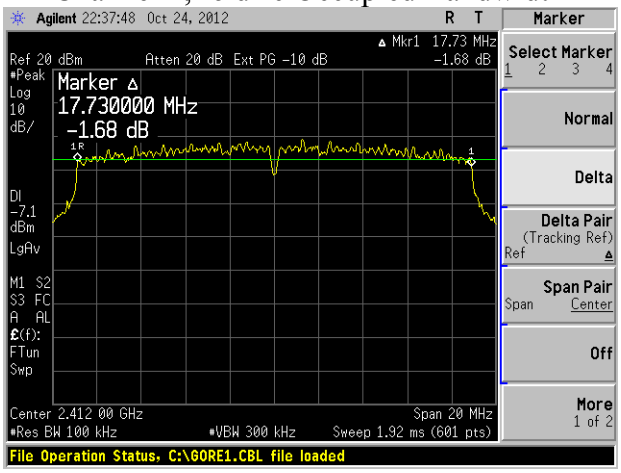


Channel 11, -6 dBc Occupied Bandwidth

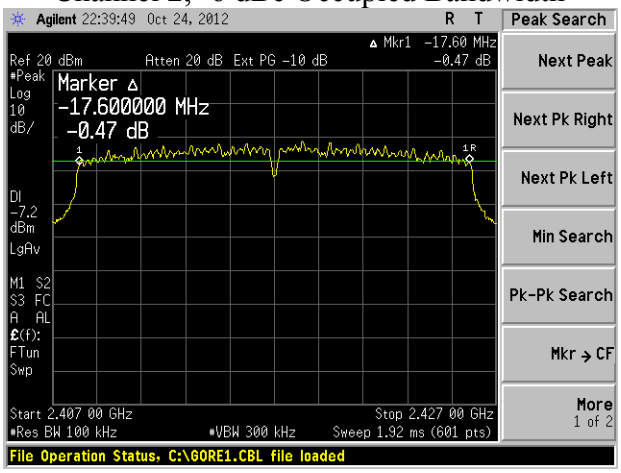


MCS7

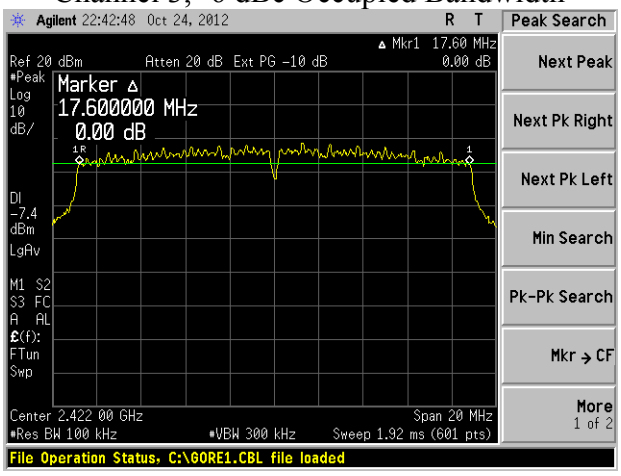
Channel 1, -6 dBc Occupied Bandwidth



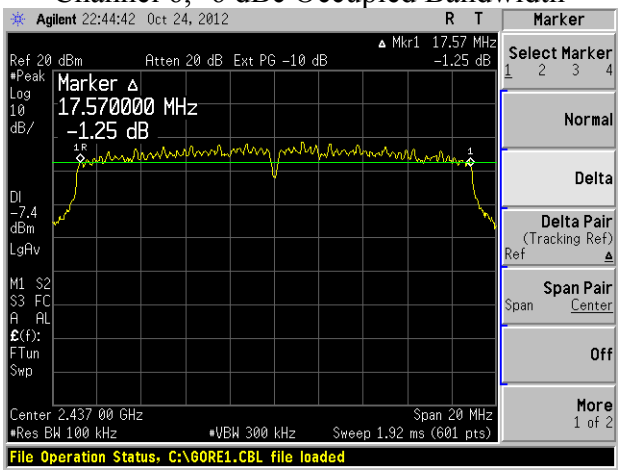
Channel 2, -6 dBc Occupied Bandwidth



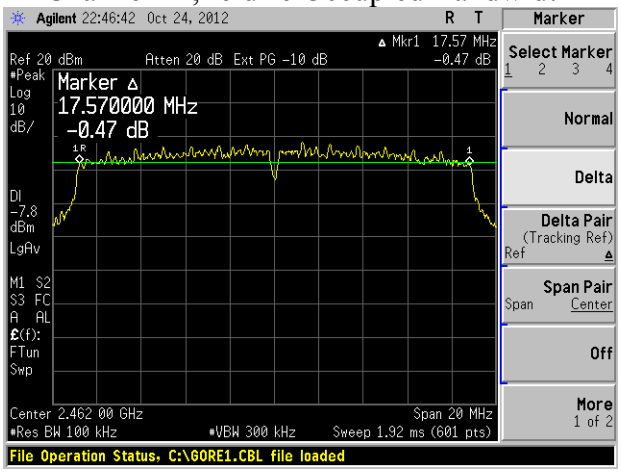
Channel 3, -6 dBc Occupied Bandwidth



Channel 6, -6 dBc Occupied Bandwidth

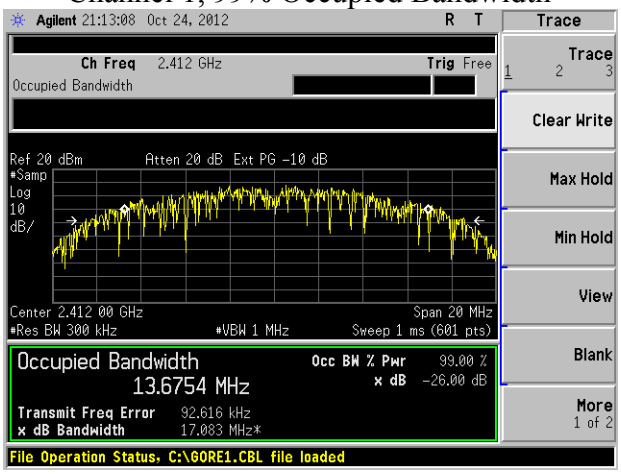


Channel 11, -6 dBc Occupied Bandwidth

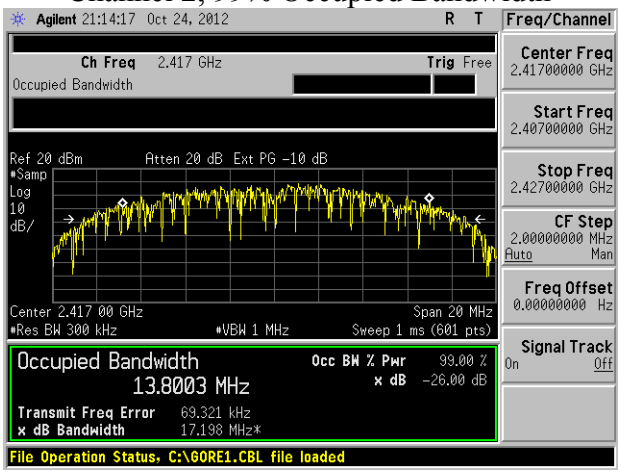


1 MBPS

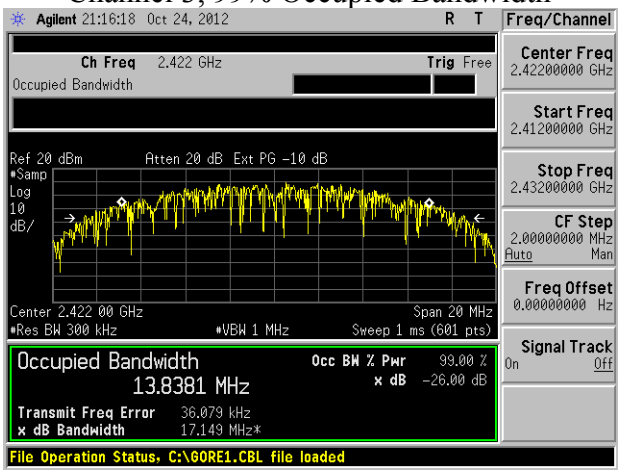
Channel 1, 99% Occupied Bandwidth



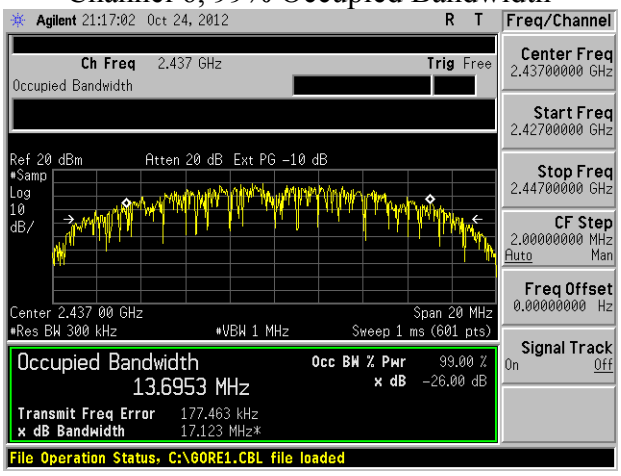
Channel 2, 99% Occupied Bandwidth



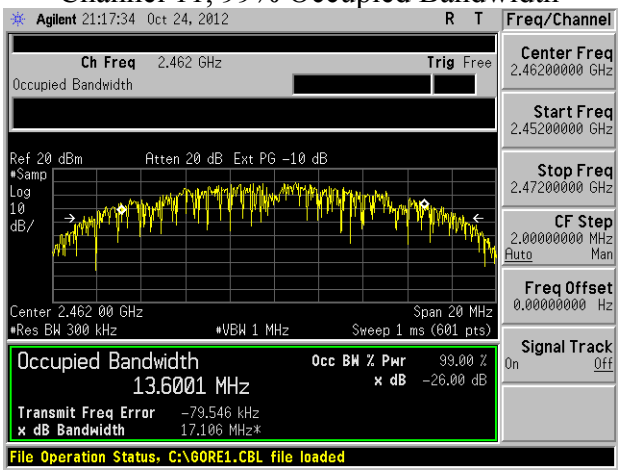
Channel 3, 99% Occupied Bandwidth



Channel 6, 99% Occupied Bandwidth

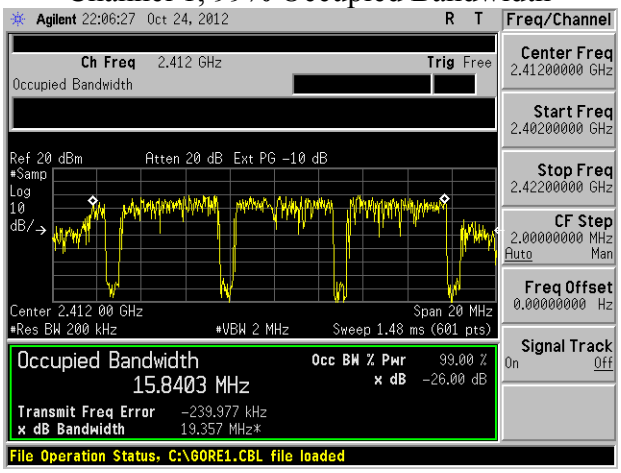


Channel 11, 99% Occupied Bandwidth

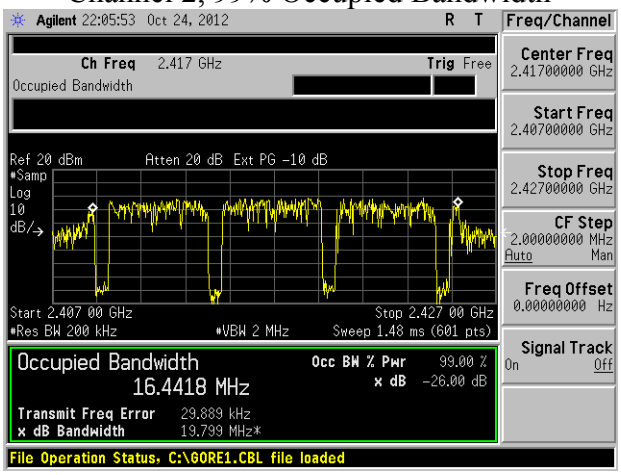


54 MBPS

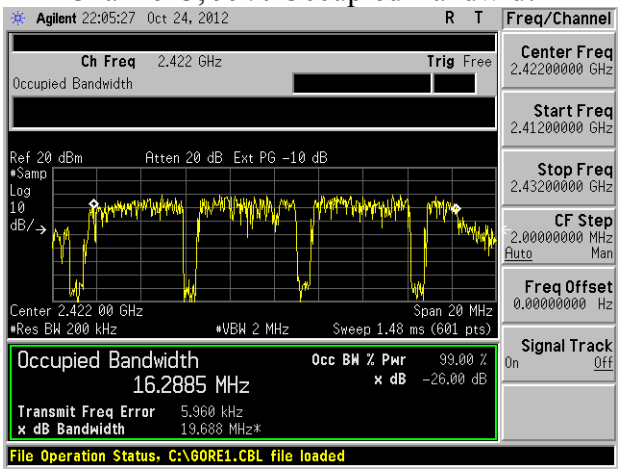
Channel 1, 99% Occupied Bandwidth



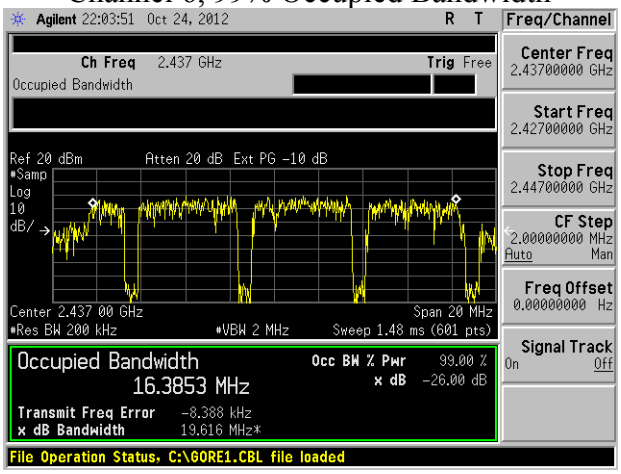
Channel 2, 99% Occupied Bandwidth



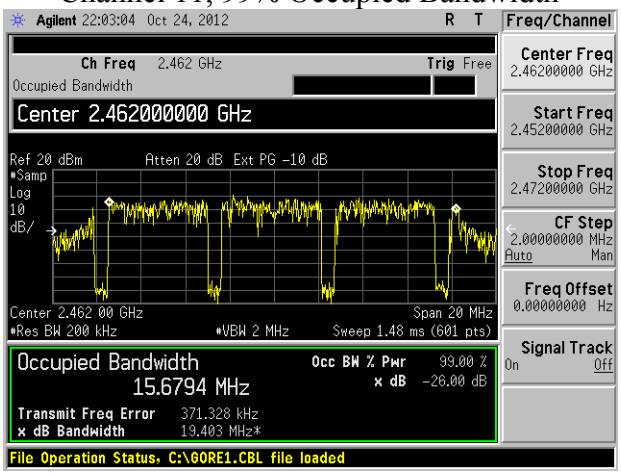
Channel 3, 99% Occupied Bandwidth



Channel 6, 99% Occupied Bandwidth

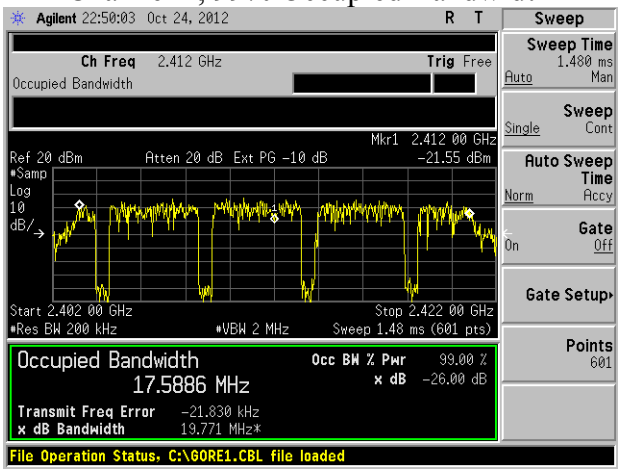


Channel 11, 99% Occupied Bandwidth

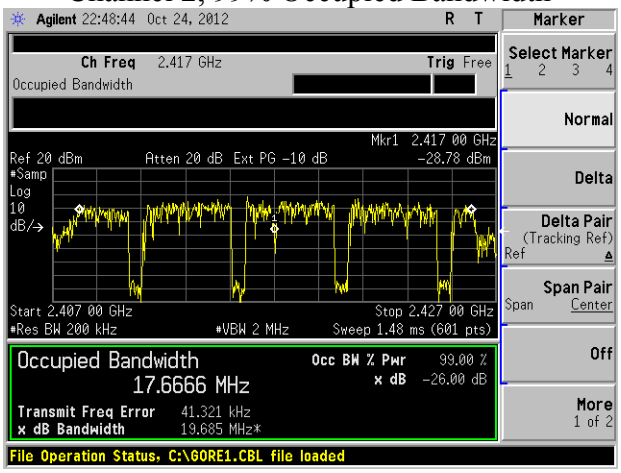


MCS7

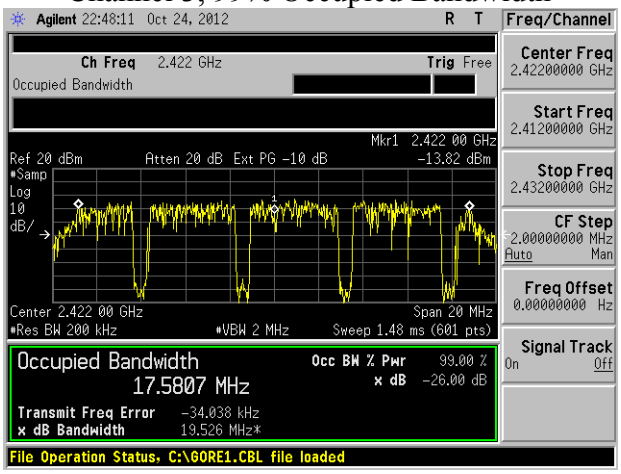
Channel 1, 99% Occupied Bandwidth



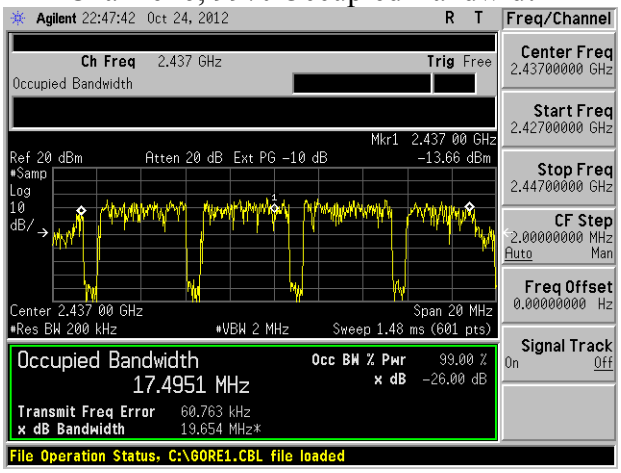
Channel 2, 99% Occupied Bandwidth



Channel 3, 99% Occupied Bandwidth



Channel 6, 99% Occupied Bandwidth



Channel 11, 99% Occupied Bandwidth

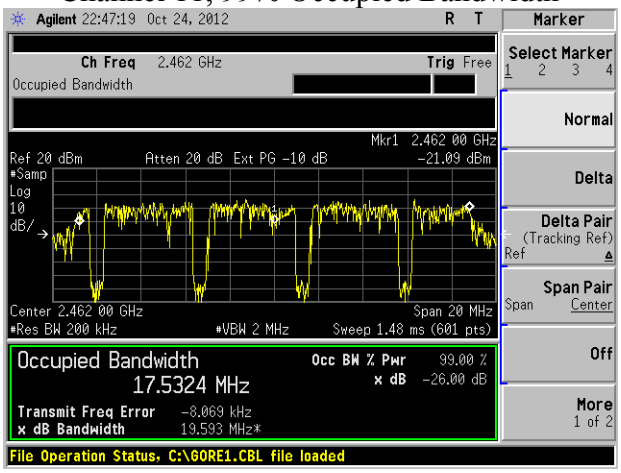


EXHIBIT 8. BAND-EDGE MEASUREMENTS

8.1 Limits

For a 2.4 GHz Transmitter:

The 2310-2390 MHz Lower Band-Edge average limit, in the case, would be +54 dBuV/m at 3m.
The 2310-2390 MHz Lower Band-Edge peak limit, in the case, would be +74 dBuV/m at 3m.

In the 2390-2400 MHz band, a -20 dBc limit is observed.

The 2483.5-2500 MHz Upper Band-Edge average limit, in this case, would be +54 dBuV/m at 3m.
The 2483.5-2500 MHz Upper Band-Edge peak limit, in this case, would be +74 dBuV/m at 3m.

8.2 Method of Measurements

The test setup was assembled in accordance with ANSI C63.10. The EUT was placed on an 80cm high non-conductive pedestal, centered on a flush mounted 2-meter diameter turntable inside a 3-meter semi-anechoic, FCC listed Chamber. The EUT was operated in and final testing was performed using continuous transmit mode. The unit was operated on the low and high channels.

The following screen captures demonstrate compliance of the intentional radiator in 15.205 restricted bands at the 2400-2483.5 MHz Band-Edges. The EUT was operated in continuous transmit mode with continuous modulation, with internally generated data as the modulating source.

8.3 Test Results

Please see Appendix A

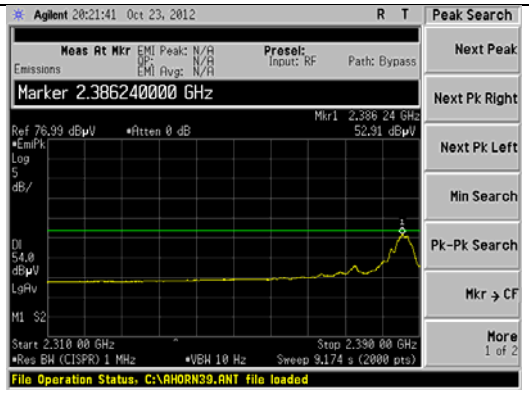
8.4 Test Results

The respective limits were not exceeded, yielding a passing result for all results outlined in the following section.

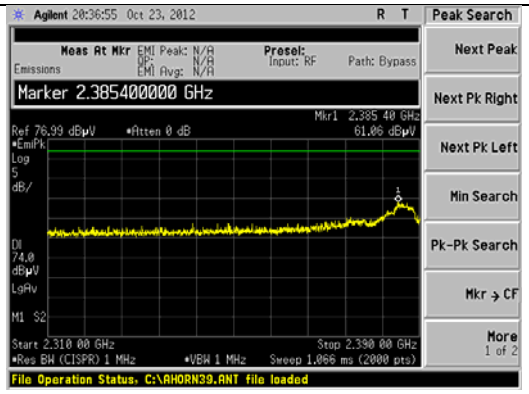
8.5 Screen Captures

Wi-Fi: Screen Capture Demonstrating Compliance at the 2310-2390 MHz Lower Band-Edge

1 MBPS, Channel 1

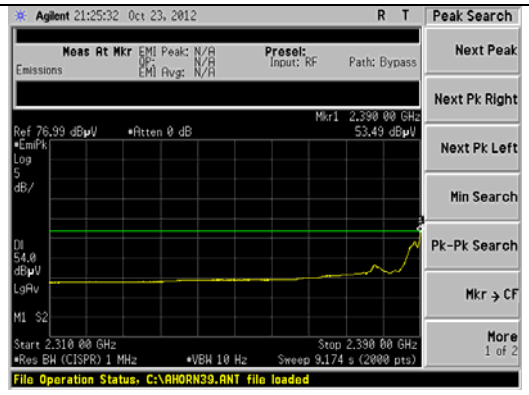


Average Measurement

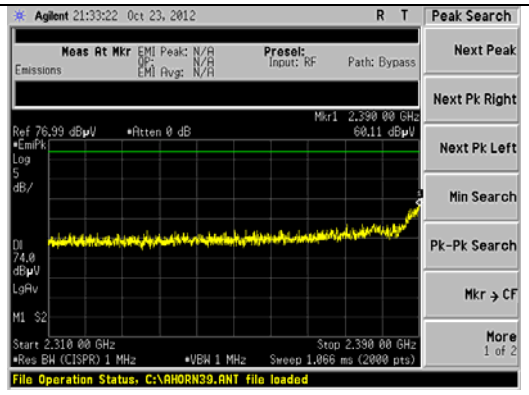


Peak Measurement

1 MBPS, Channel 2

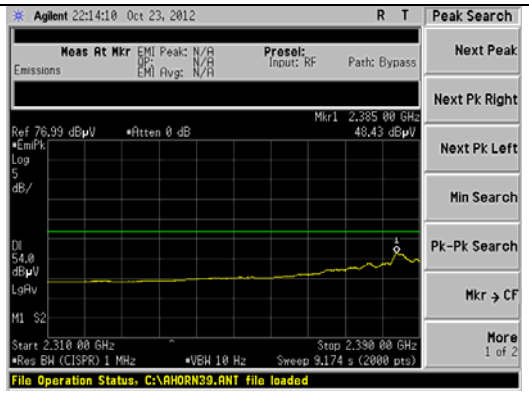


Average Measurement

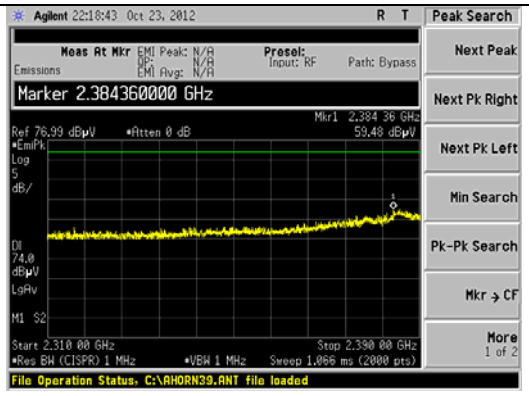


Peak Measurement

1 MBPS, Channel 3

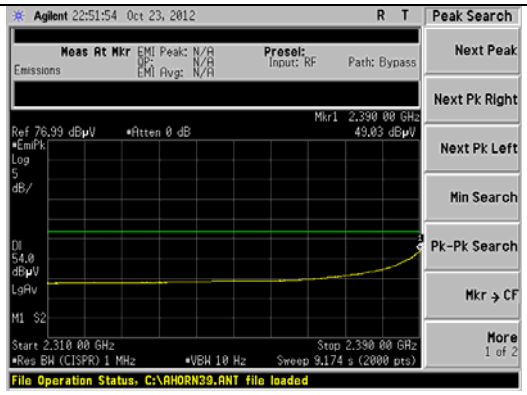


Average Measurement

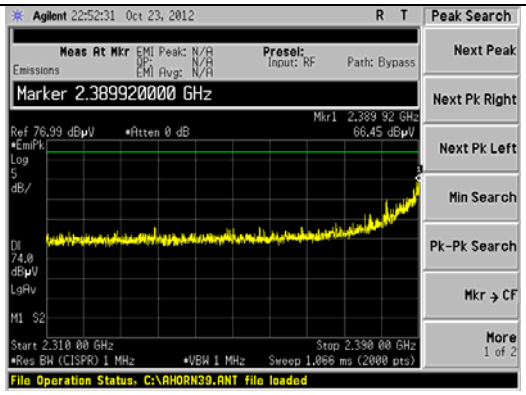


Peak Measurement

54 MBPS, Channel 1

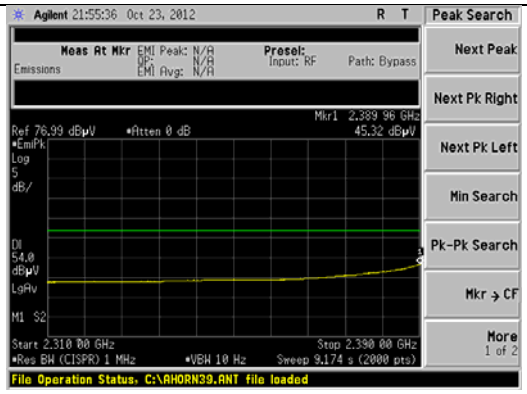


Average Measurement

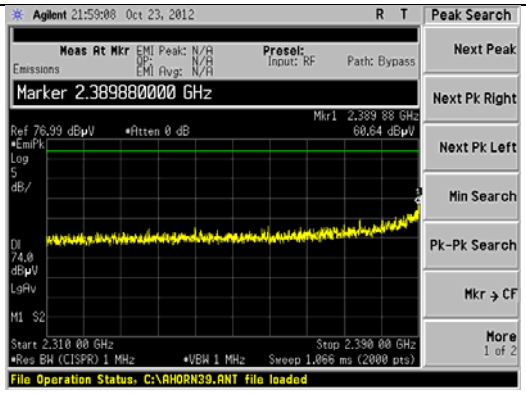


Peak Measurement

54 MBPS, Channel 2

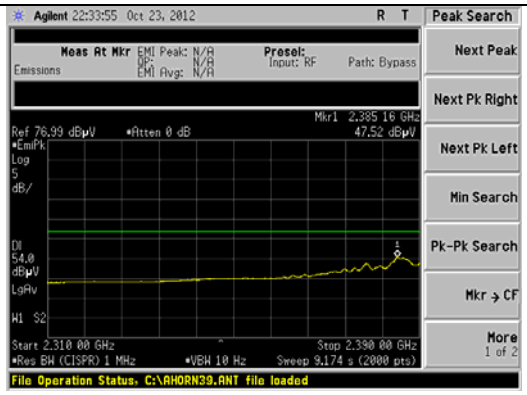


Average Measurement

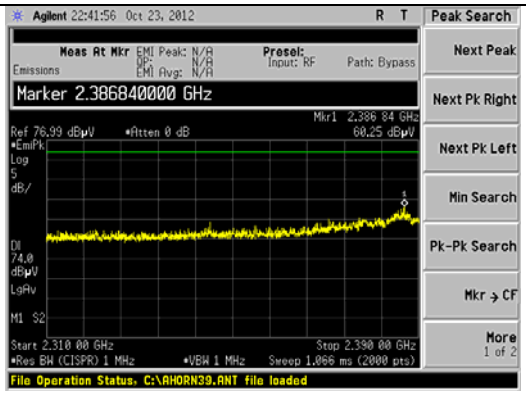


Peak Measurement

54 MBPS, Channel 3

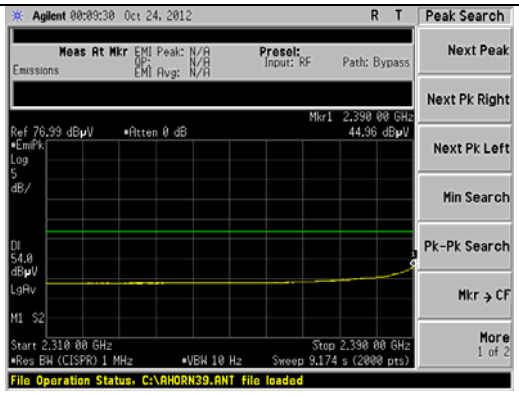


Average Measurement

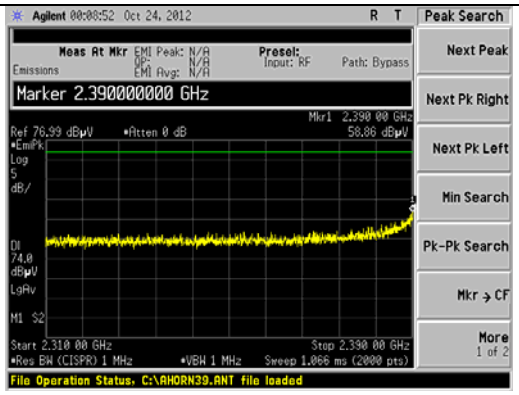


Peak Measurement

MCS7, Channel 1

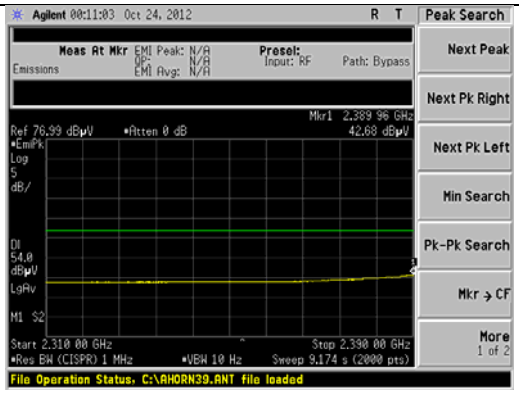


Average Measurement

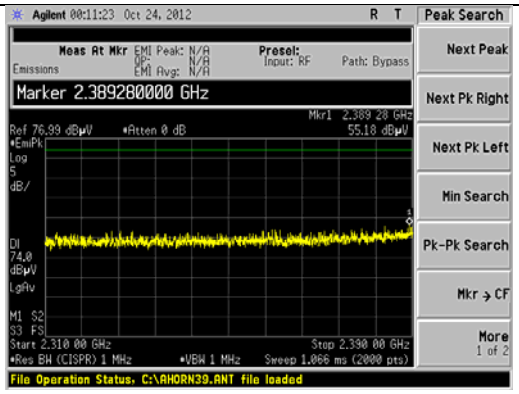


Peak Measurement

MCS7, Channel 2

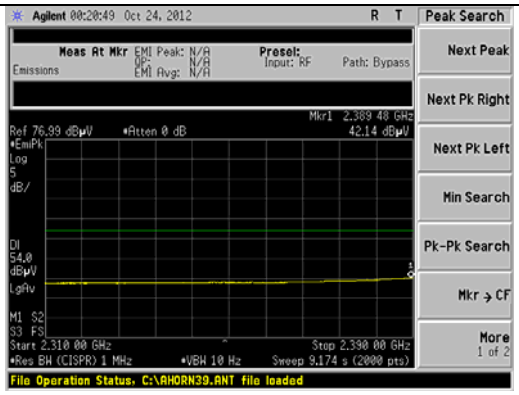


Average Measurement

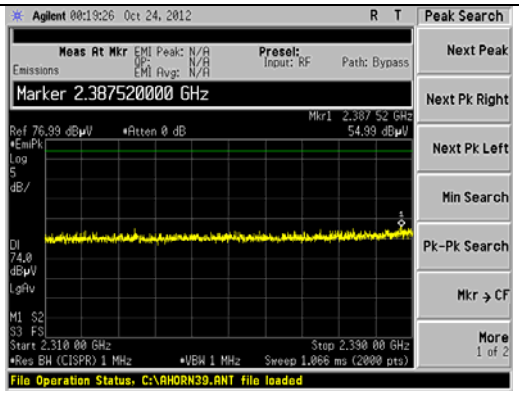


Peak Measurement

MCS7, Channel 3

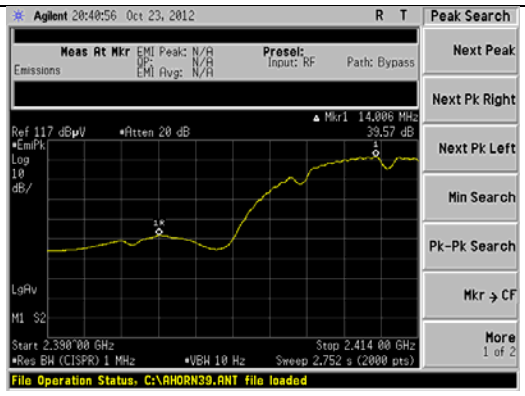
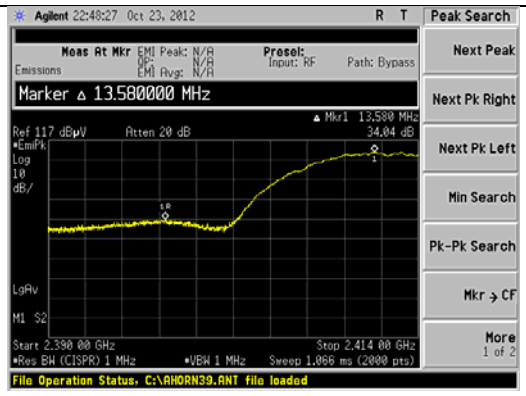
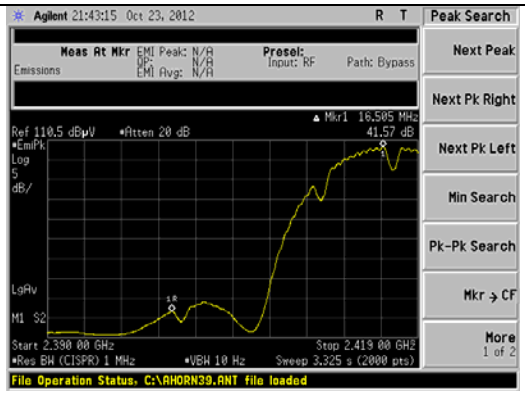
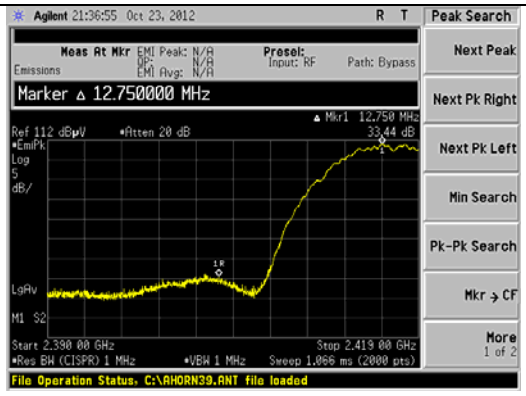
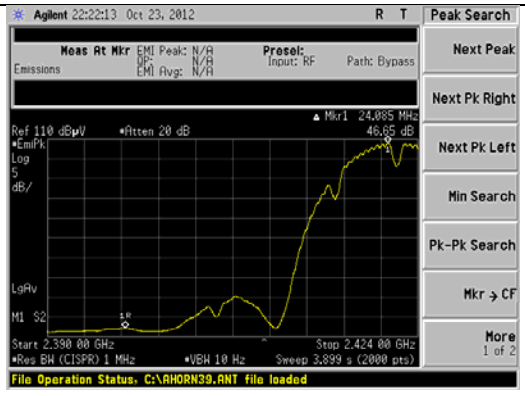
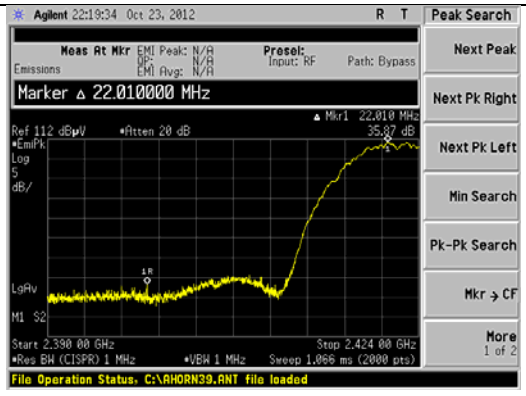


Average Measurement

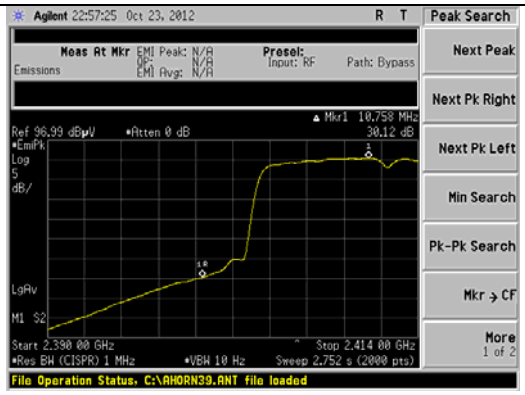


Peak Measurement

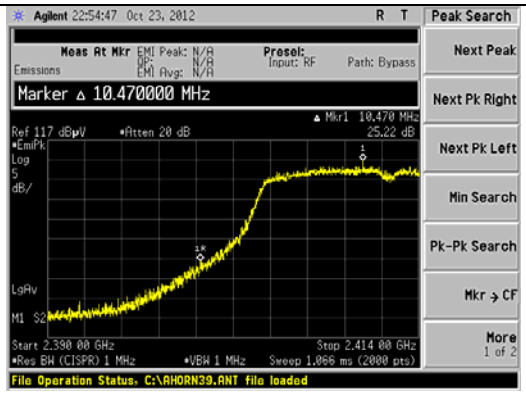
Wi-Fi: Screen Capture Demonstrating Compliance at the 2390-2400 MHz Lower Band-Edge

1 MBPS, Channel 1	
	
Average Measurement	Peak Measurement
1 MBPS, Channel 2	
	
Average Measurement	Peak Measurement
1 MBPS, Channel 3	
	
Average Measurement	Peak Measurement

54 MBPS, Channel 1

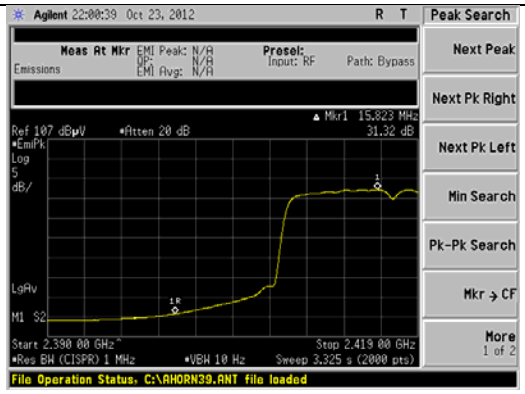


Average Measurement

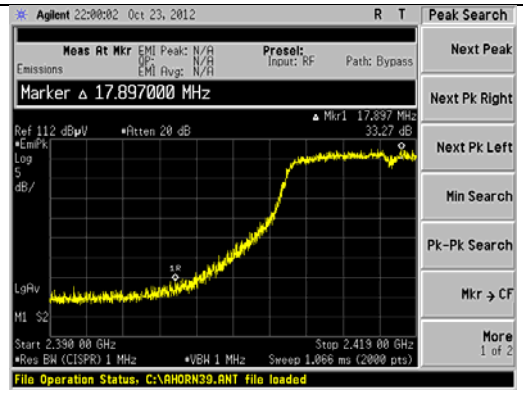


Peak Measurement

54 MBPS, Channel 2

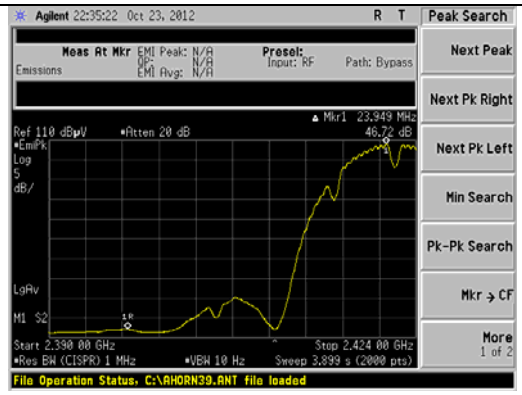


Average Measurement

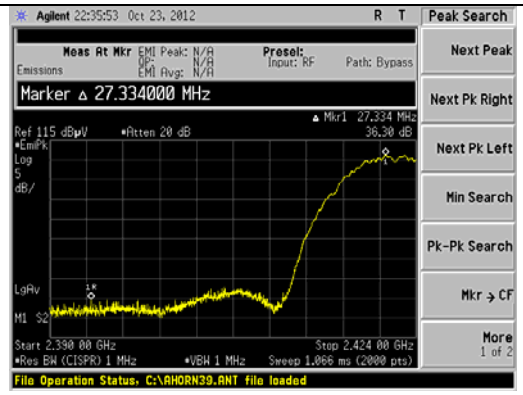


Peak Measurement

54 MBPS, Channel 3

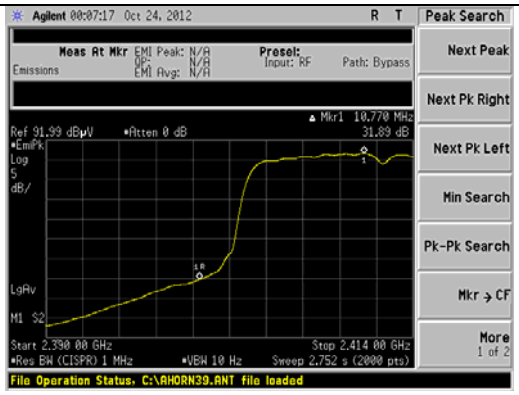


Average Measurement

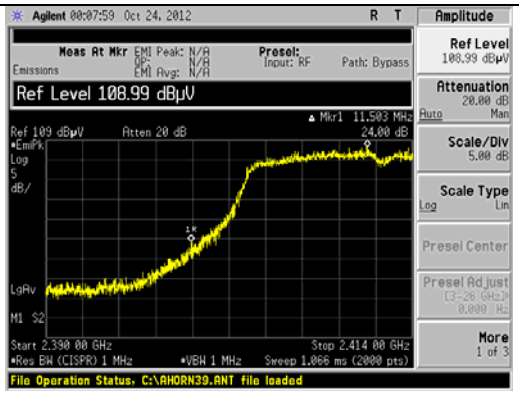


Peak Measurement

MCS7, Channel 1

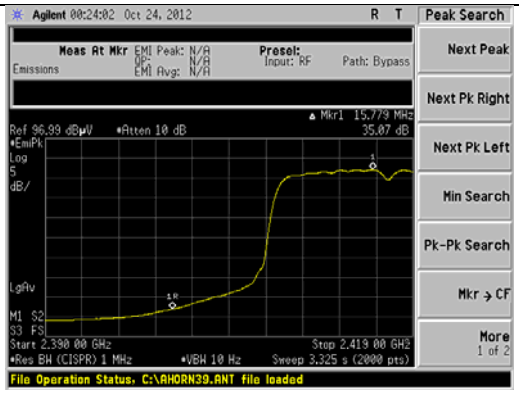


Average Measurement

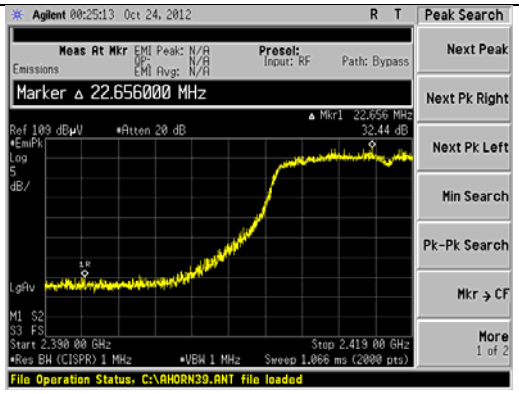


Peak Measurement

MCS7, Channel 2

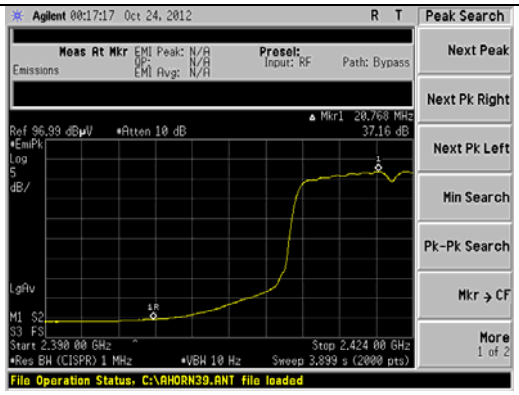


Average Measurement

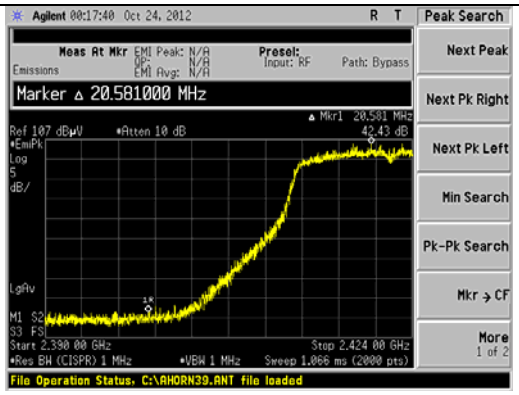


Peak Measurement

MCS7, Channel 3



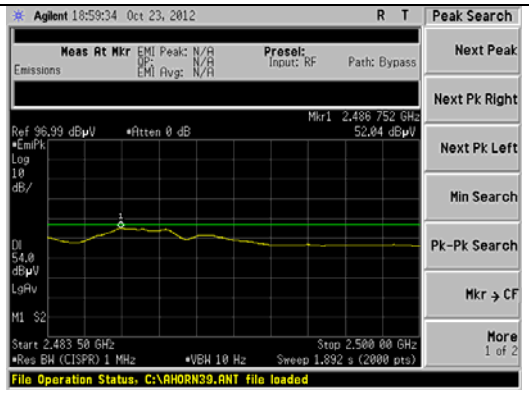
Average Measurement



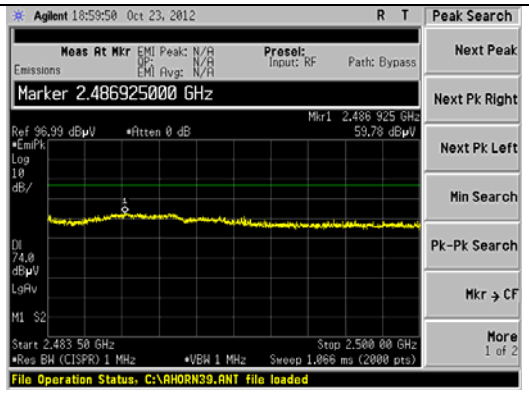
Peak Measurement

Screen Capture Demonstrating Compliance at the 2483.5-2500 MHz Upper Band-Edge

1 MBPS, Channel 11

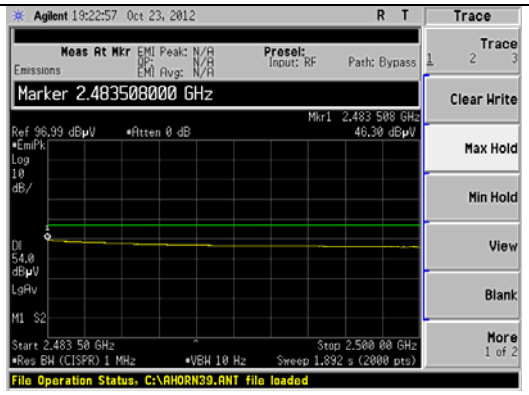


Average Measurement

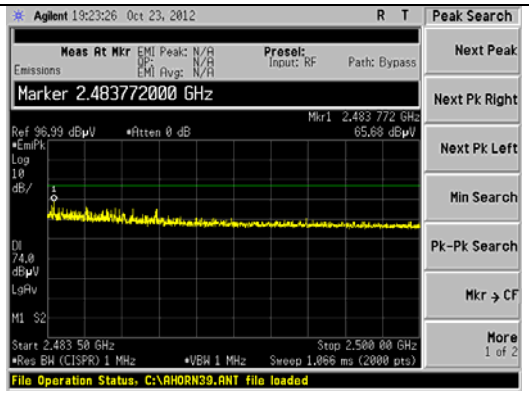


Peak Measurement

54 MBPS, Channel 11

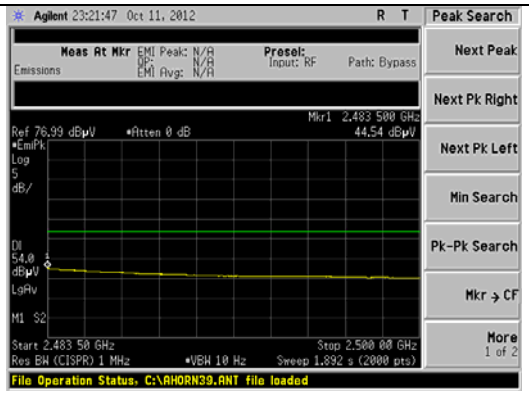


Average Measurement

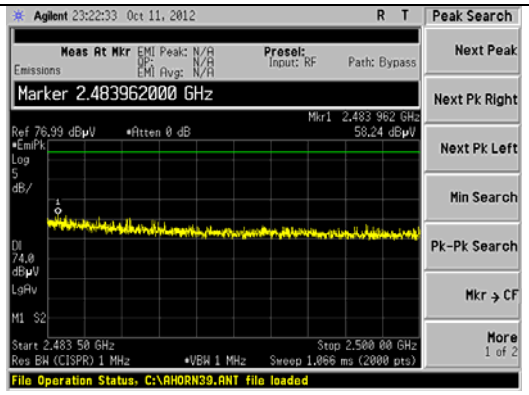


Peak Measurement

MCS7, Channel 11



Average Measurement



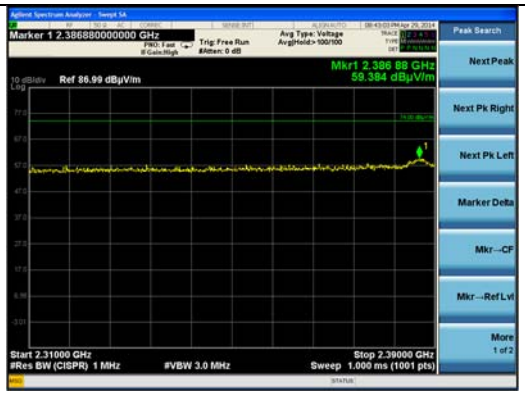
Peak Measurement

Radiated Emissions in Enclosure

Wi-Fi: Screen Capture Demonstrating Compliance at the 2310-2390 MHz Lower Band-Edge

1 MBPS, Channel 1

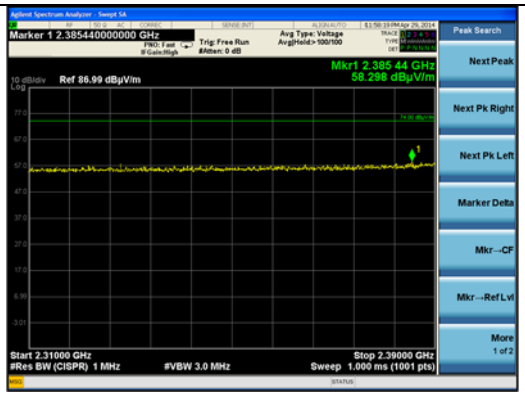
Average Measurement



Peak Measurement

1 MBPS, Channel 2

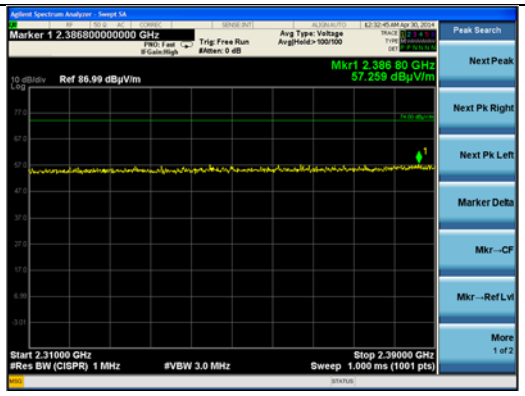
Average Measurement



Peak Measurement

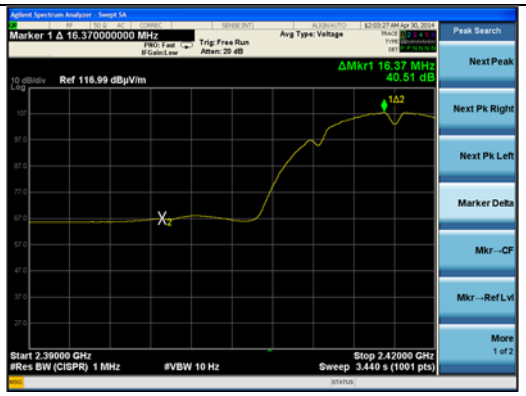
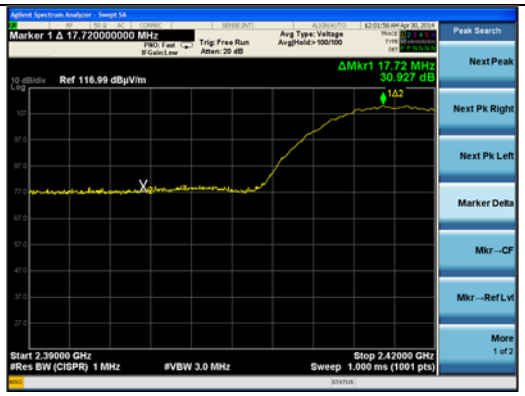
1 MBPS, Channel 3

Average Measurement



Peak Measurement

Wi-Fi: Screen Capture Demonstrating Compliance at the 2390-2400 MHz Lower Band-Edge

1 MBPS, Channel 1	
	
Average Measurement	Peak Measurement
1 MBPS, Channel 2	
	
Average Measurement	Peak Measurement
1 MBPS, Channel 3	
	
Average Measurement	Peak Measurement

Screen Capture Demonstrating Compliance at the 2483.5-2500 MHz Upper Band-Edge

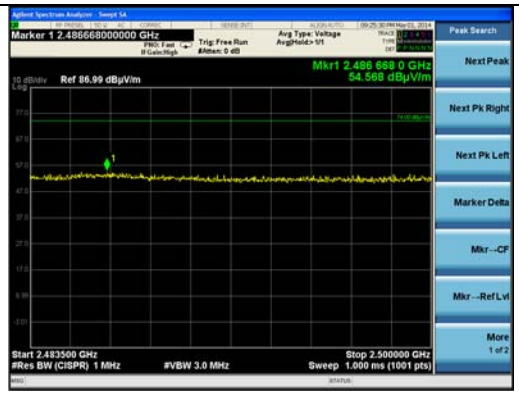
1 MBPS, Channel 11	
	
Average Measurement	Peak Measurement

EXHIBIT 9. POWER OUTPUT (CONDUCTED): 15.247(b)

9.1 Method of Measurements

The conducted RF output power of the EUT was measured at the antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, allowing direct measurements without the need for any further corrections. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. Measurements from a peak detector are presented in the charts below.

9.2 Test Equipment List

Please see Appendix A

9.3 Test Results

From this data, the closest measurement when compared to the specified limit is 21.4 dBm, which is below the limit of 29.0 dBm by 7.6 dBm.

9.4 Test Data

WLAN

1 MBPS

Chan	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
1	2412	19.9	29.0	9.1
2	2417	20.5	29.0	8.5
3	2422	21.3	29.0	7.8
6	2437	21.2	29.0	7.8
11	2462	21.4	29.0	7.6

54 MBPS

Chan	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
1	2412	17.7	29.0	11.3
2	2417	17.4	29.0	11.6
3	2422	17.6	29.0	11.4
6	2437	17.5	29.0	11.5
11	2462	17.2	29.0	11.8

MCS7

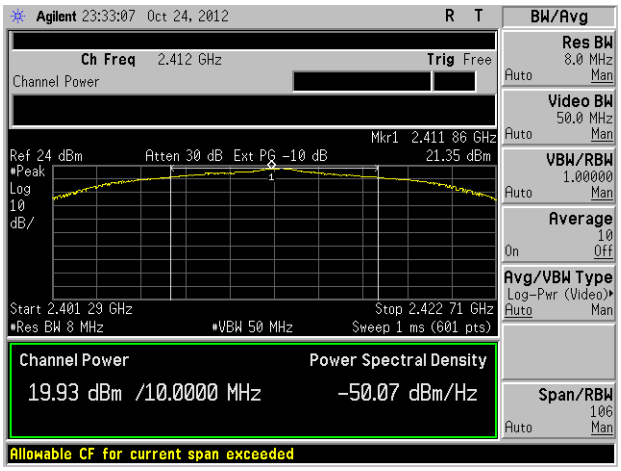
Chan	Frequency (MHz)	Power (dBm)	Limit (dBm)	Margin (dB)
1	2412	14.4	29.0	14.6
2	2417	14.3	29.0	14.7
3	2422	14.4	29.0	14.6
6	2437	14.4	29.0	14.6
11	2462	13.8	29.0	15.2

9.5 Screen Captures – Power Output (Conducted)

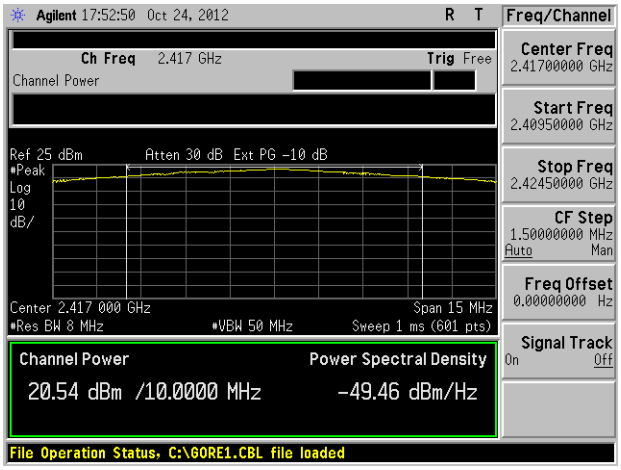
WLAN

1 MBPS

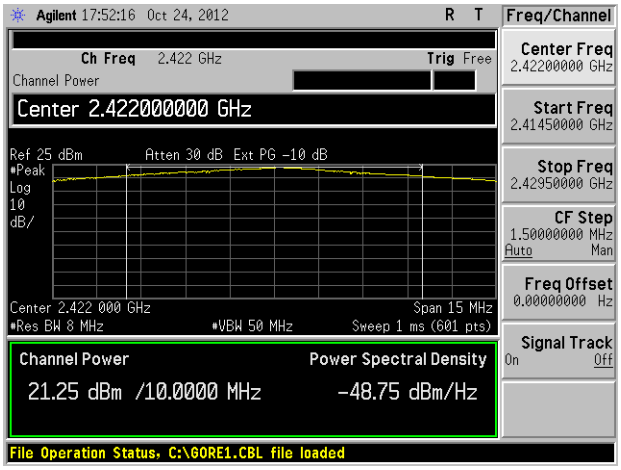
Channel 1



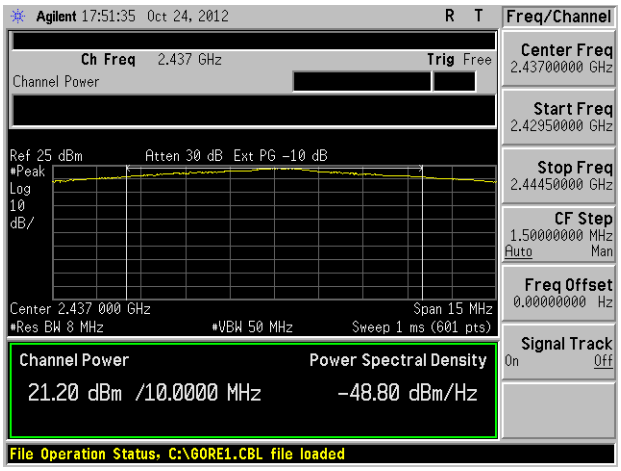
Channel 2



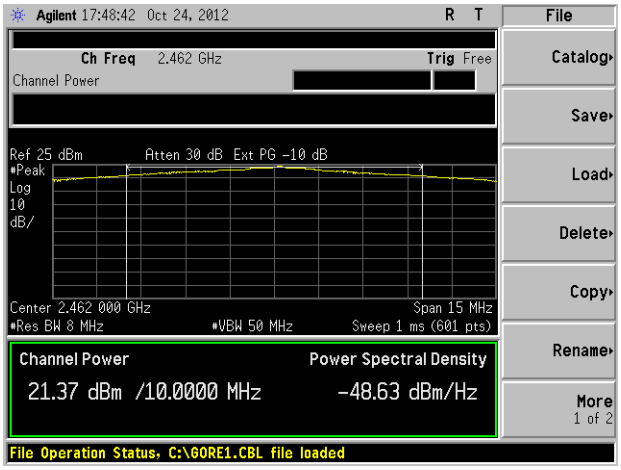
Channel 3



Channel 6

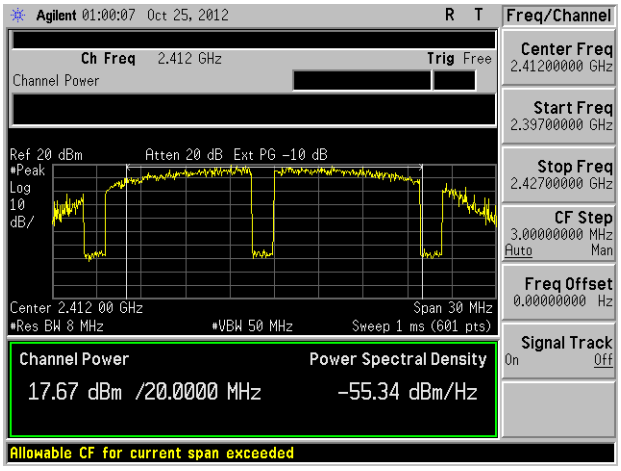


Channel 11

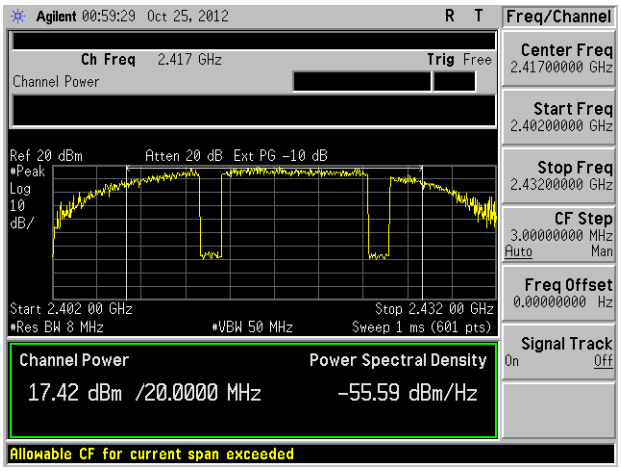


54 MBPS

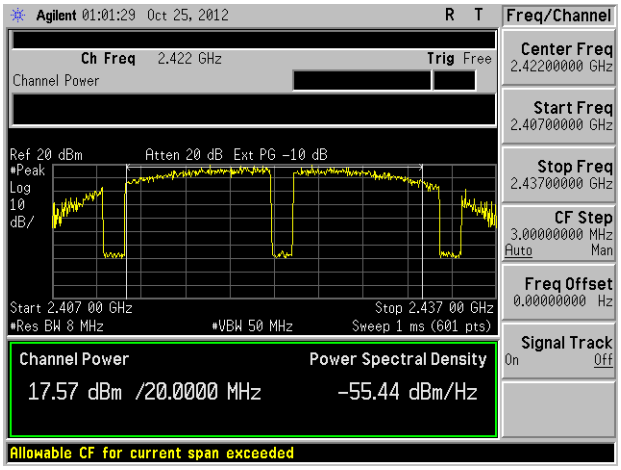
Channel 1



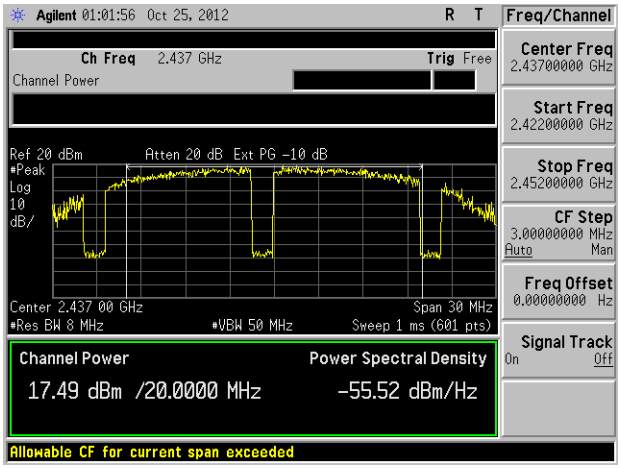
Channel 2



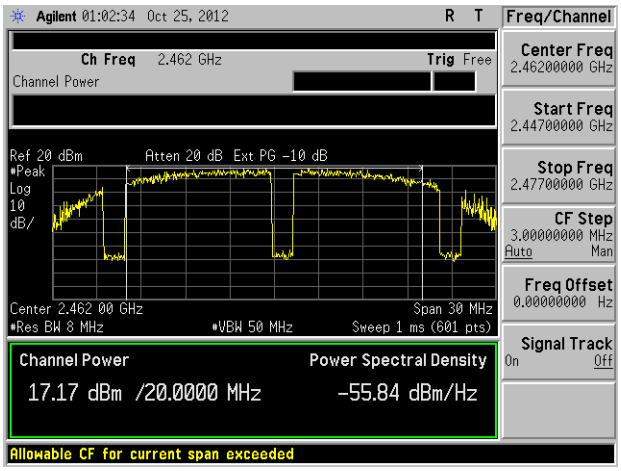
Channel 3



Channel 6

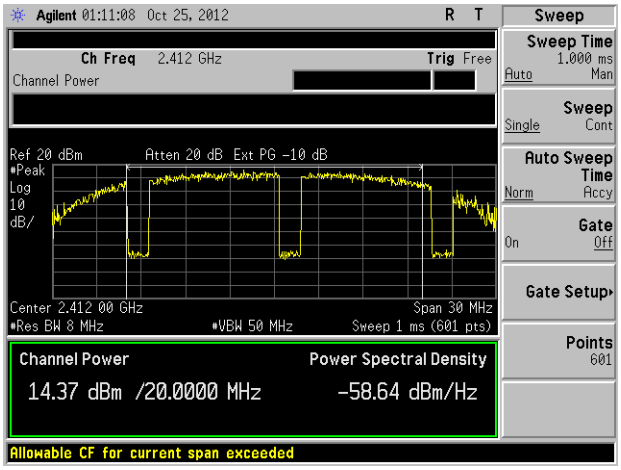


Channel 11

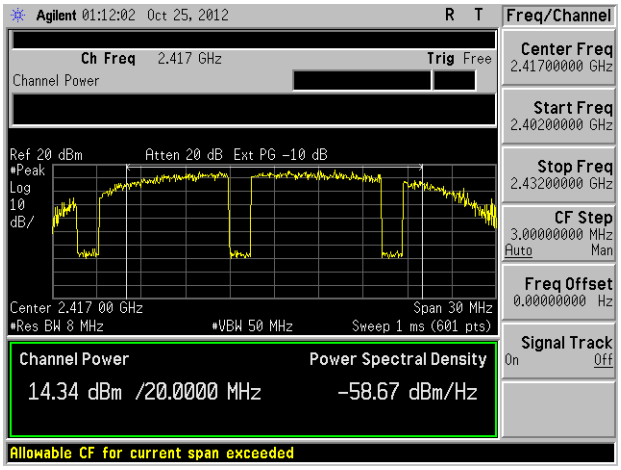


MCS7

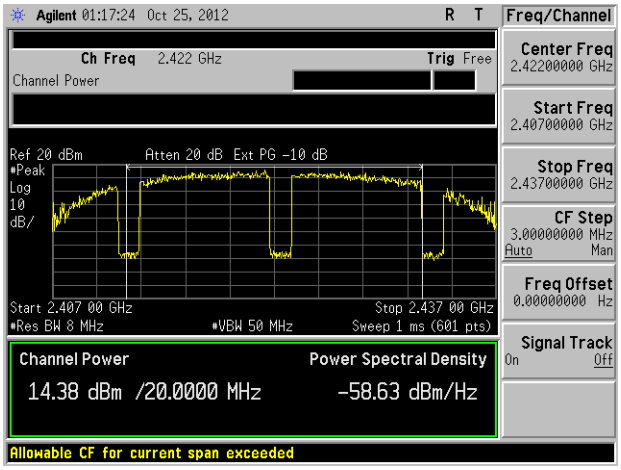
Channel 1



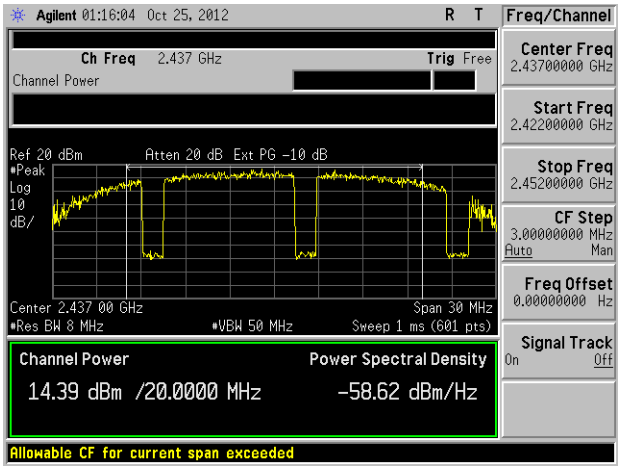
Channel 2



Channel 3



Channel 6



Channel 11

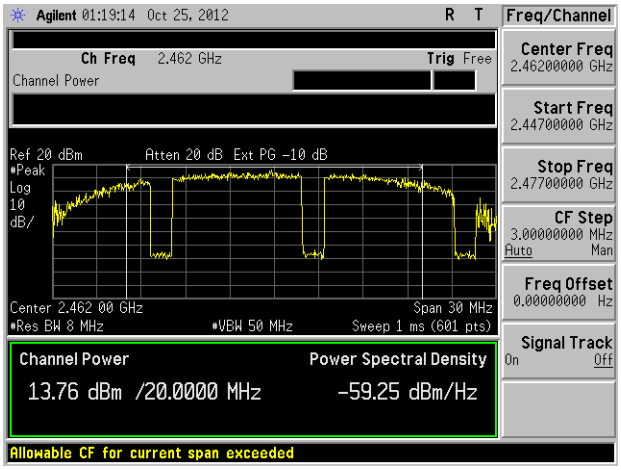


EXHIBIT 10 POWER SPECTRAL DENSITY: 15.247(e)

10.1 Limits

For digitally modulated systems the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

In accordance with FCC Part 15.247(e) and RSS 210 A8.2(b), the peak power spectral density should not exceed +8 dBm in any 3 kHz band.

10.2 Test Result

The highest density was found to be no greater than -3.2 dBm, which is under the allowable limit by 11.2 dB.

10.3 Test Equipment List

Please see Appendix A

10.4 Test Data

WLAN

1 MBPS

Chan	PSD/3kHz	PKPSD Limit	Margin
1	-5.1	8.0	13.1
2	-4.7	8.0	12.7
3	-3.6	8.0	11.6
6	-3.2	8.0	11.2
11	-3.9	8.0	11.9

54 MBPS

Chan	PSD/3kHz	PKPSD Limit	Margin
1	-12.15	8.0	20.15
2	-12.64	8.0	20.64
3	-12.47	8.0	20.47
6	-13.37	8.0	21.37
11	-12.69	8.0	20.69

MCS7

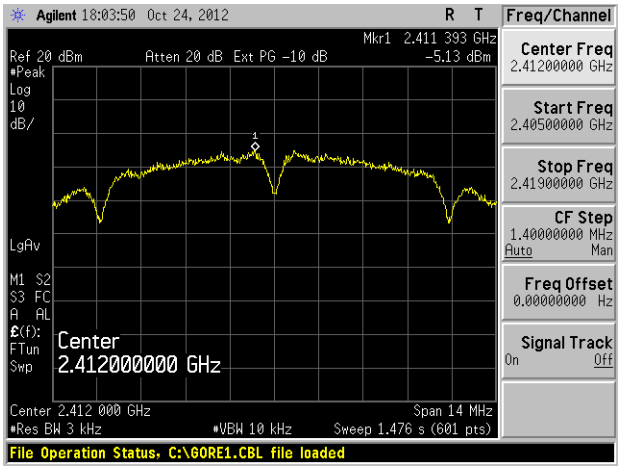
Chan	PSD/3kHz	PKPSD Limit	Margin
1	-15.25	8.0	23.25
2	-15.73	8.0	23.73
3	-15.97	8.0	23.97
6	-16.59	8.0	24.59
11	-16.23	8.0	24.23

10.5 Screen Captures – Power Spectral Density

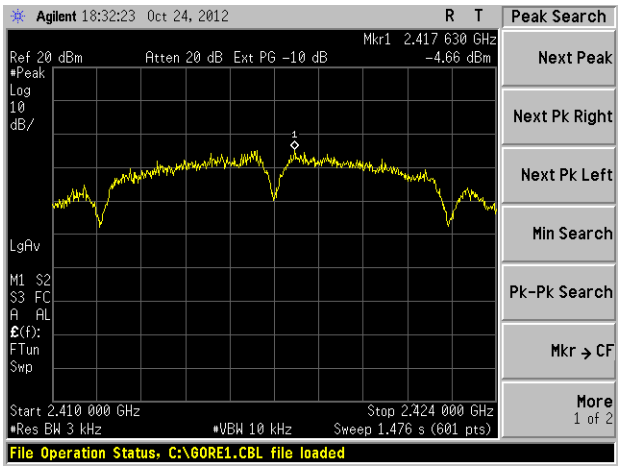
WLAN

1 MBPS

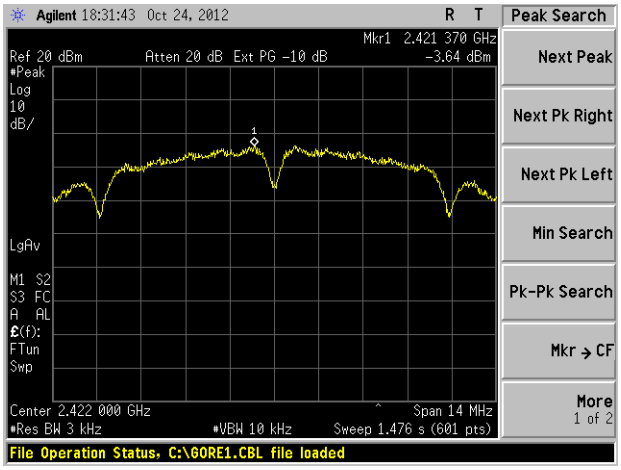
Channel 1



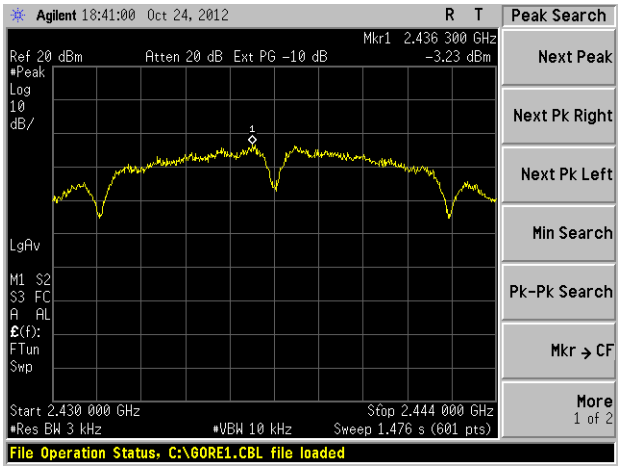
Channel 2



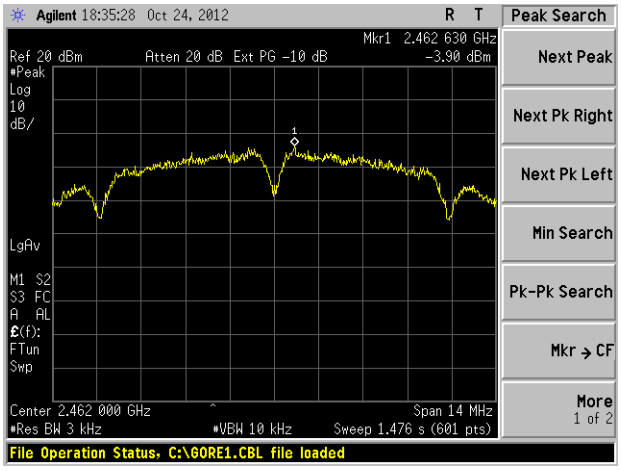
Channel 3



Channel 6

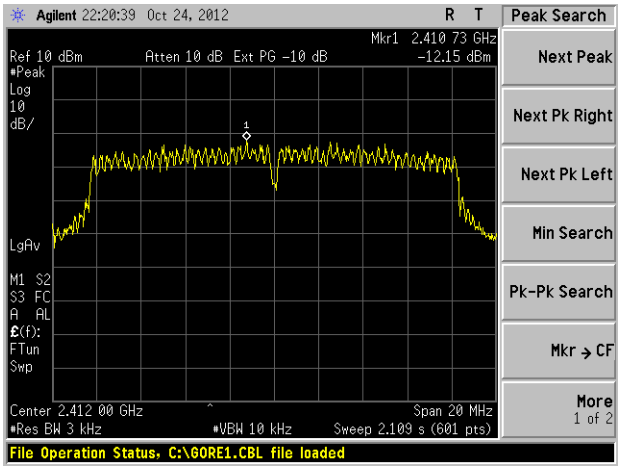


Channel 11

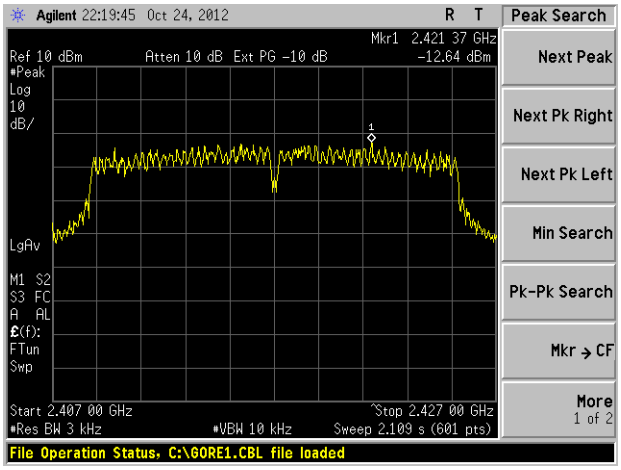


54MBPS

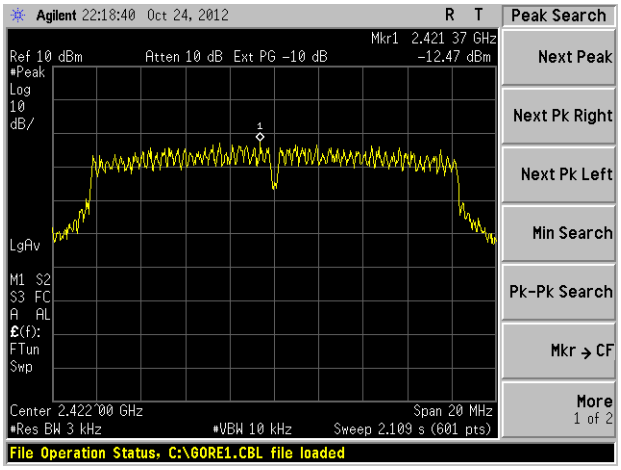
Channel 1



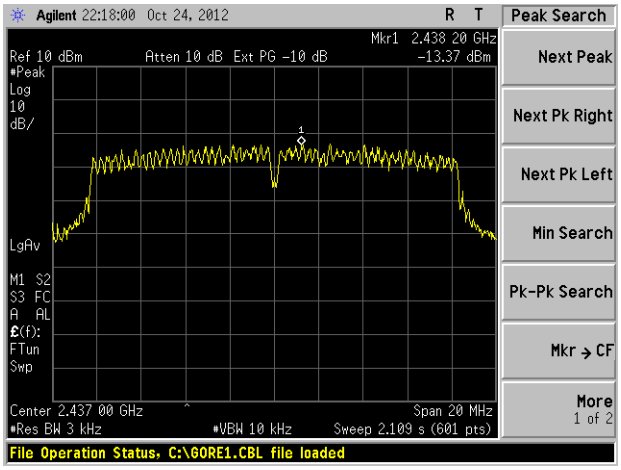
Channel 2



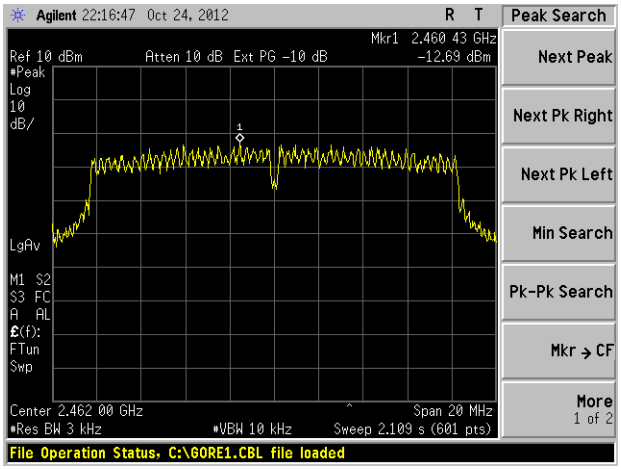
Channel 3



Channel 6

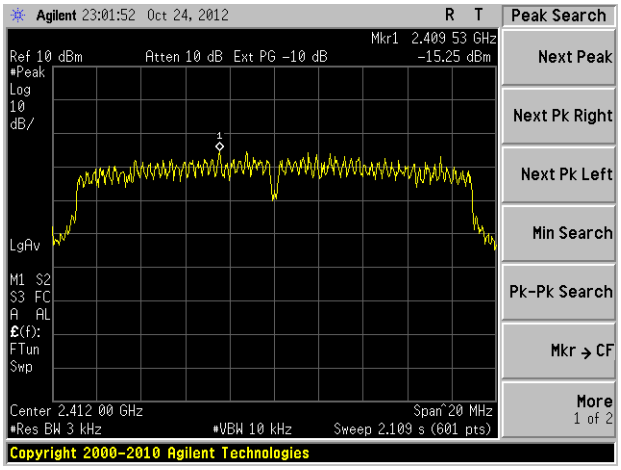


Channel 11

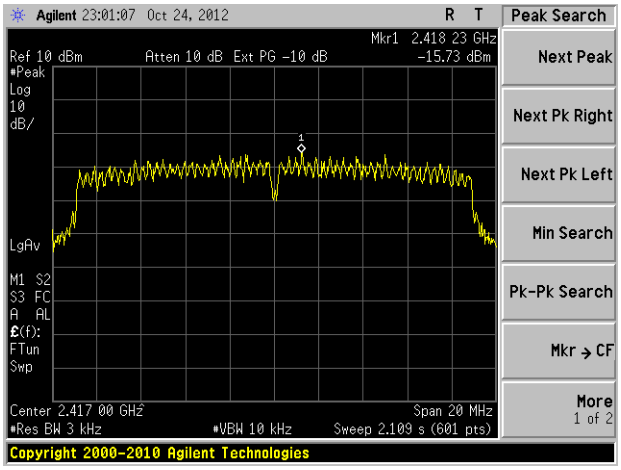


MCS7

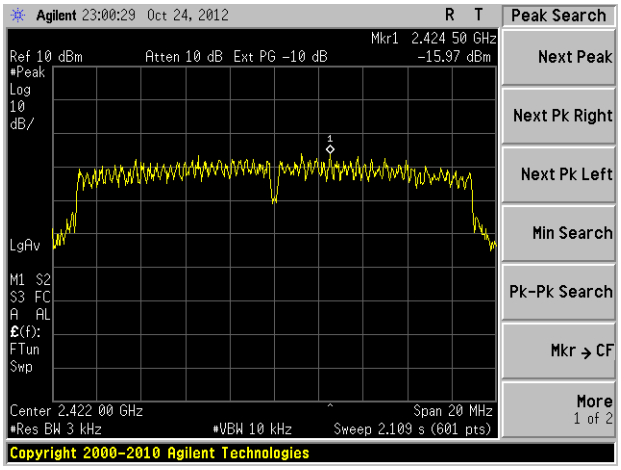
Channel 1



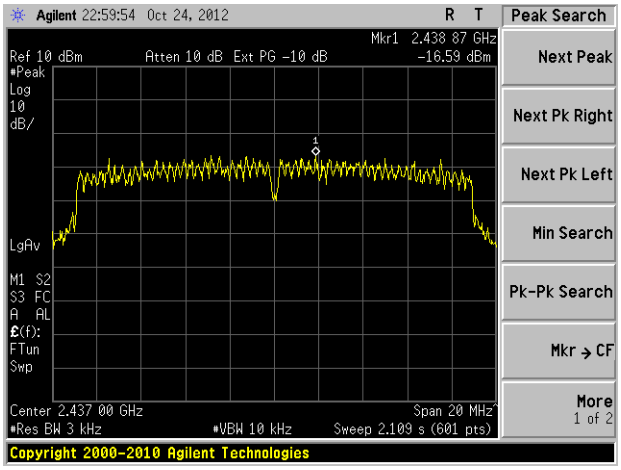
Channel 2



Channel 3



Channel 6



Channel 11

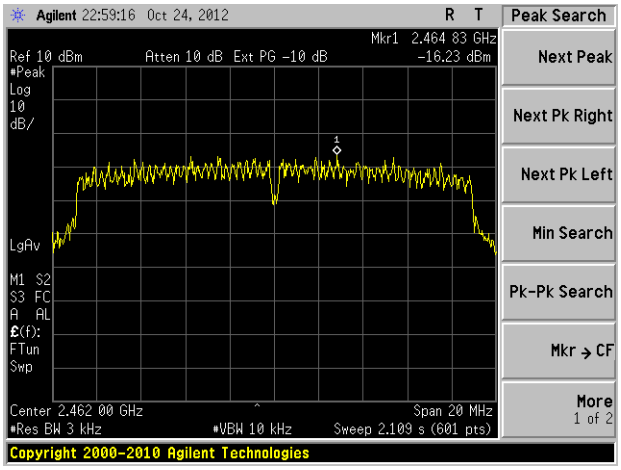


EXHIBIT 11. CONDUCTED SPURIOUS EMISSIONS: 15.247(d)

11.1 - Limits

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

11.2 – Conducted Harmonic And Spurious RF Measurements

FCC Part 15.247(d) and IC RSS 210 A8.5 both require a measurement of conducted harmonic and spurious RF emission levels, as reference to the carrier level when measured in a 100 kHz bandwidth. For this test, the spurious and harmonic RF emissions from the EUT were measured at the EUT antenna port using a short RF cable along with an attenuator as protection for the spectrum analyzer. The loss from the cable and the attenuator were added on the analyzer as gain offset settings, thereby allowing direct readings of the measurements made without the need for any further corrections. A spectrum analyzer was used with the resolution bandwidth set to 100 kHz for this portion of the tests. The unit was configured to run in a continuous transmit mode, while being supplied with typical data as a modulation source. The spectrum analyzer was used with measurements from a peak detector presented in the chart below. Screen captures were acquired and any noticeable spurious and harmonic signals were identified and measured.

11.3 – Test Equipment List

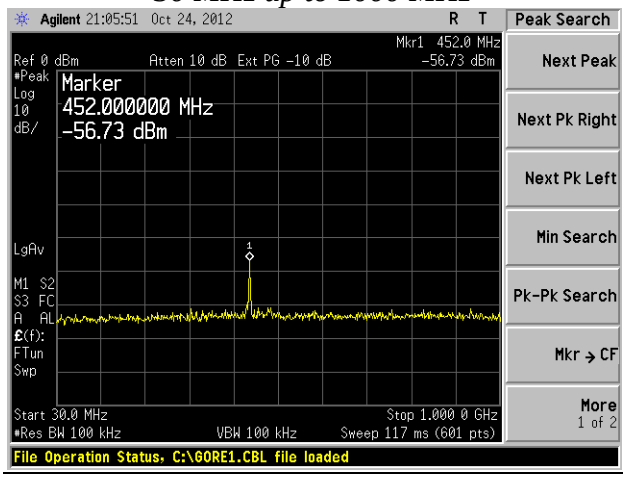
Please see Appendix A

11.4- Screen Captures – Spurious Radiated Emissions

The following captures are representative of the product. Measurements were taken on three channels. Low channel emissions are shown below and are representative of the product.

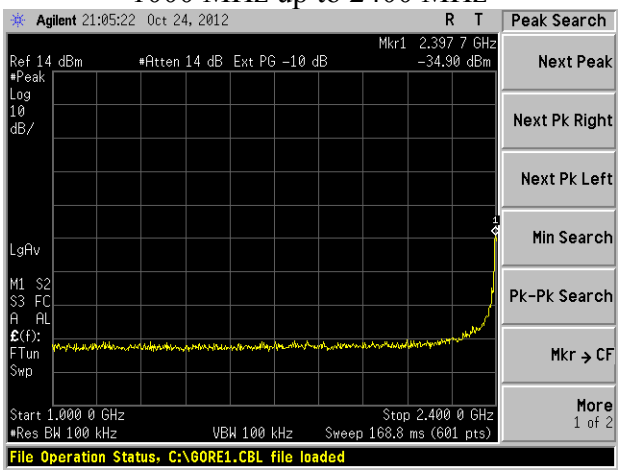
Wi-Fi:

30 MHz up to 1000 MHz

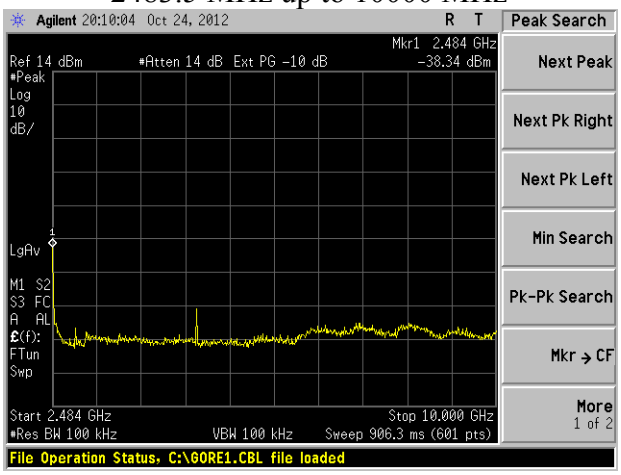


Conducted Spurious Emissions Screen Captures (cont.)

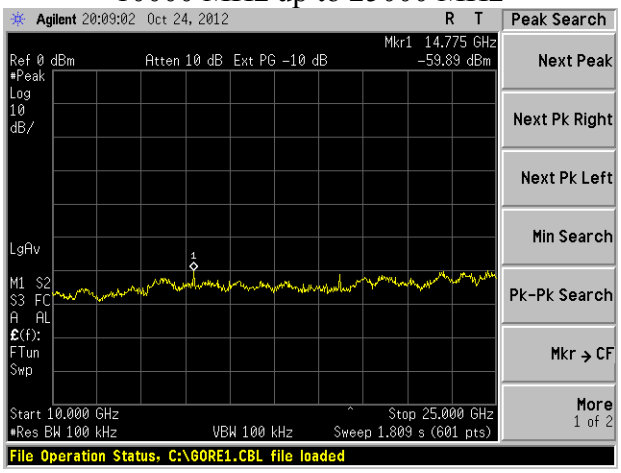
1000 MHz up to 2400 MHz



2483.5 MHz up to 10000 MHz



10000 MHz up to 25000 MHz



APPENDIX A
List of Test Equipment

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Oct-2012 Type Test : Radiated Emissions Job # : C-1568

Prepared By: Customer : Johnson Outdoors Marine Electronics Quote #: 312067

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960007	Double Ridge Horn Antenna	EMCO	3115	9311-4138	5/16/2012	5/16/2013	Active Calibration
2	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/29/2012	6/29/2013	Active Calibration
3	AA 960078	Log Periodic Antenna	EMCO	93146	9701-4855	11/15/2011	11/15/2012	Active Calibration
4	AA 960005	Biconical Antenna	EMCO	93110B	9601-2280	6/26/2012	6/26/2013	Active Calibration
5	AA 960144	Phaseflex	Gore	EKD01D010720	5800373	6/1/2011	6/1/2013	Active Calibration
6	EE 960156	100kHz-1GHz Analog Signal Generator	Agilent	N5181A	MY49060062	6/30/2012	6/30/2013	Active Calibration
7	EE 960157	3Hz-13.2GHz Spectrum Analyzer	Agilent	E4445A	MY48250225	6/29/2012	6/29/2013	Active Calibration
8	EE 960158	RF Preselecter	Agilent	N9039A	MY46520110	6/29/2012	6/29/2013	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Oct-2012 Type Test : Conducted Emissions Job # : C-1568

Prepared By: Customer : Johnson Outdoors Marine Electronics Quote #: 312067

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960031	Transient Limiter	HP	11947A	3107A01708	9/2/2012	9/2/2013	Active Calibration
2	AA 960008	LISN	EMCO	3816/2NM	9701-1057	1/3/2012	1/3/2013	Active Calibration
3	EE 960013	EMI Receiver	HP	8546A System	3617A00320;3448A	11/22/2011	11/22/2012	Active Calibration
4	EE 960014	EMI Receiver-filter section	HP	85460A	3448A00296	11/22/2011	11/22/2012	Active Calibration

LS RESEARCH LLC
Wireless Product Development
Equipment Calibration

Date : 11-Oct-2012 Type Test : Conducted Radio Emissions Job # : C-1568

Prepared By: Customer : Johnson Outdoors Marine Electronics Quote #: 312067

No.	Asset #	Description	Manufacturer	Model #	Serial #	Cal Date	Cal Due Date	Equipment Status
1	AA 960143	Phaseflex	Gore	EKD01D01048.0	5546519	6/1/2011	6/1/2013	Active Calibration
2	CC 000221C	Spectrum Analyzer	HP	E4407B	US39160256	6/5/2012	6/5/2013	Active Calibration
3	EE 960073	Spectrum Analyzer	Agilent	E4446A	US45300564	5/9/2012	5/9/2013	Active Calibration

APPENDIX B

TEST STANDARDS: CURRENT PUBLICATION DATES

STANDARD #	DATE	Am. 1	Am. 2
ANSI C63.4	2003		
ANSI C63.10	2009		
FCC 47 CFR, Parts 0-15, 18, 90, 95	2012		
CISPR 22	2009-05	2009-12 P	
RSS GEN	2010-12		
RSS 210	2010-12		

APPENDIX C

Uncertainty Statement

This uncertainty represents an expanded uncertainty expressed at approximately the 95 % confidence level, using a coverage factor of k=2.

Table of Expanded Uncertainty Values, (K=2) for Specified Measurements

Measurement Type	Particular Configuration	Uncertainty Values
Radiated Emissions	*3 – Meter chamber, Biconical Antenna*	*4.82 dB*
Radiated Emissions	*3-Meter Chamber, Log Periodic Antenna*	*4.88 dB*
Radiated Emissions	*3-Meter Chamber, Horn Antenna*	*4.85 dB*
Radiated Emissions	*10-Meter OATS, Biconical Antenna*	*4.32 dB*
Radiated Emissions	*10-Meter OATS, Log Periodic Antenna*	*3.63 dB*
Absolute Conducted Emissions	*Agilent PSA/ESA Series*	*1.38 dB*
AC Line Conducted Emissions	*Shielded Room/EMCO LISN*	*3.20 dB*
Radiated Immunity	*3 Volts/Meter in 3-Meter Chamber*	*2.05 Volts/Meter*
Conducted Immunity	*3 Volts level*	*2.33 V*
EFT Burst, Surge, VDI	*230 VAC*	*54.4 V*
ESD Immunity	*Discharge at 15kV*	*3200 V*
Temperature/Humidity	*Thermo-hygrometer*	*0.64° / 2.88 %RH*